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ABSTRACT

This study is based on the annual statistics of 35 institutions, all members of the Association of Research Libraries. For 17 of the libraries, the statistics cover 1969-1988; for the rest, they cover 1976-1988. Procedurally, the study parallels both its 1987 ancestor ("Research Library Trends, 1951-1980 and Beyond") and the earlier "Purdue Study" series, but here the 35 libraries are separate from, and many are smaller and younger than the 58 included in the earlier work. The study describes growth and change in library holdings, volumes added, professional and non-professional staff size, and expenditures for salaries and for materials and binding. Figures for graduate enrollment and Ph.D. degrees awarded are also included. Expenditures, the most regular and predictable of the trends studied, are expected to continue to increase at a rate of about 8%-9% per year. Collections, which probably will continue to increase as a result of something like a "flywheel effect" (the continuing motion of a large mass that has been in motion "forever"), will probably not continue to double in less than 20-year intervals, as was common in the past; current rates of increase for collections are well below those of the 1960's, and they may decline further. Eight appendices include a listing of the nine Purdue study reports; an excerpt and references from an earlier report; lists of National Center for Education Statistics and Canadian data source documents; Canadian and U.S. dollar conversion factors; tables and figures displaying selected data; and inflation factors. An index is provided. (Contains 48 references). (BBM)

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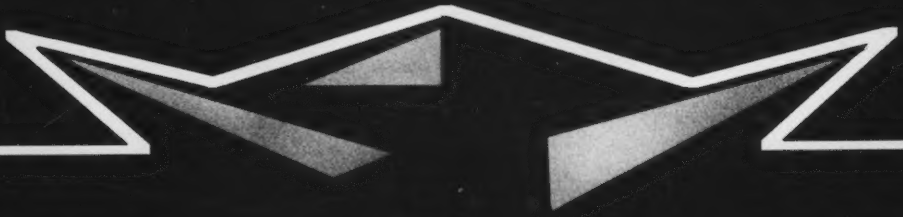

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Research Library Trends II: 35 Libraries in the 1970's and Beyond

A Sequel to Research Library Trends, 1951-1980 and Beyond

by

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A Technical Report of the
Lister Hill National Center for
Biomedical Communications
National Library of Medicine

Abstract

This study is a sequel to Research Library Trends, 1951-1980 and Beyond (1987) and it is based on the annual statistics of 35 institutions, all of them members of the Association of Research Libraries. Procedurally, the study parallels both its 1987 ancestor and the earlier "Purdue study" series, but here the 35 libraries are separate from, and many are smaller and younger than, the 58 included in the earlier work. At a minimum, the statistics here span the years from 1976 through 1988 (a shorter span than the earlier studies included), but in 17 cases, they extend back through 1969, and this is fortunate because it provides the data needed to trace trends throughout the difficult decade of the 1970's.

The evidence shows that, even though the rate at which libraries added volumes to collections declined in 14 or 15 of the last 19 years--including 1986-1988--and even though "VA" finally was 30 percent below its 1969 level, collections still grew at rates near those that Rider and Purdue had found. After 1969, the 17 "old" libraries' median collection doubled in 17+ (and their average in 18+) years, and since 1976, the average and median collections of the 35 libraries have increased at rates that would yield a doubling in 19 years or less, if past rates were maintained. Between 1976 and 1988, their average collection increased from 1.380 million volumes to 2.036 million. Although spending increased at slower rates than the 1987 study had found, the rates still were near eight percent per year, which leads to a doubling in about nine years. Between 1969 and 1988, average total spending of the 17 libraries increased from $2.507 million to $10.378 million, primarily as a result of inflation. Salary and wage spending increased similarly, but materials and binding expenditures fared less well, particularly during the earlier years. Salary and wage spending is usually about 55 percent of the total, but this has declined recently, while materials and binding is usually just over a third, and this has been increasing gradually.

Total library staff remained fairly stable until about 1981, when a series of modest increases began. Nonprofessional staff numbers followed a similar trend, and they consistently outnumbered professional staff by about 2.2 or 2.3 to 1. The libraries' current serials statistics increased noticeably until 1985, but decreased recently, ending with a 1988 average of about 20500. Institutional enrollment also increased--about 10 percent since 1976--and graduate enrollment increased even more--about 25 percent--while the awarding of doctorates proceeded differently. Awards declined until about 1981, but increased since then, reaching their highest level in 1988. (Note that these trends do not match the U. S. national trend, nor that seen in the 1987 study; in those sets of data, 1973 was the peak year, after which awards fluctuated or declined slightly through 1985. And since 1985, the U. S. national statistics have registered two small increases.)

Of the several trends that this study examines, those that relate to expenditures are the most regular and predictable, and they are expected to continue to increase at the rate of eight or perhaps nine percent per year. Collections have also increased regularly and will increase more in the years ahead, as a result, it seems, of something like a "flywheel effect," i.e., the continuing motion of a large mass that has been in motion as long as anyone can recall. Still, it is unlikely that future doubling intervals can continue to be less than 20 years because, although libraries now add volumes at rates that would have been impressive 30 years ago, if compared to rates in the late 1960's, current rates are anemic, and in most recent years, both volume counts and rates have declined and probably will decline further. No one welcomes this, and most librarians continue with efforts to prevent or reverse it, but apparently to no avail. So, if the problems of diminished growth are on the verge of effective control, there are no clear signs that show it.

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We acknowledge with thanks the help of the colleagues and friends who contributed toward the completion of this study. We could not have done without them. During the months spent collecting, reviewing, and refining the many statistical entries needed for the study, working sporadically at first, as time permitted, then concertedly, we received not only countless statistics [sic?], but good advice and support from Vance Grant, National Center for Education Statistics, and Lucie Cadotte, Statistics Canada; Maxine Sitts, formerly at the Association of Research Libraries, now at the Commission on Preservation and Access; Kendon Stubbs, the Alderman Library, University of Virginia; Lori Thurgood, Doctorate Records Project, National Research Council; and more than forty individuals in the libraries and the registrars' and graduate school offices of the 28 U. S. and seven Canadian universities represented here.

We are particularly indebted to Anne McInnis of McMaster U.; James MacLean, U. of Western Ontario; and William Watson, U. of British Columbia, whose replies to inquiries were always precise, prompt, and cordial. With their help and the help of so many others, a statistical base was developed, elusive statistics were found and added, questionable entries were reviewed and rectified, and the full complement of statistics was finally assembled and made ready for analysis.

We are grateful, too, for encouraging words that have added seasoning to the work and that served more than once to blunt or neutralize doubts that came from other quarters. No one can deny that library trend studies, begun by Rider almost 50 years ago (Rider, 1940), have not become large or popular favorites, nor would anyone deny that most students of libraries or statistical trends have found other ways to express their interests. But we weren't so lucky, so we needed and we've welcomed the encouragement generously given by Oliver Dunn, Bill McKeachie, Martin Cummings, Bob Hayes, Kendon Stubbs, and Will Baumol. It surely was unintentional, but they also reminded us of a passage from Twain, as rendered by his impersonator, the actor Hal Holbrook:

> Anyone who starts in to carry a cat home by the tail is getting knowledge that's always goin' to be useful. It's never likely to grow dim or doubtful; [he may not] carry the cat that way again. But if he wants to, I say let 'im. It isn't always easy to be eccentric, you know."[1]

During the middle and later stages of the project, especially, there were times when we needed help to organize or reorganize the accumulating statistics, to run preliminary analyses, or to do some other piece of work, and we are grateful that we could get that help from Dick Gregg, a former colleague at NLM, who now practices Critical Care Medicine in the Washington area;

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[1] In Holbrook's recording, Mark Twain Tonight, the sentences that precede the cat parable might also qualify as an early excursion into information science or quantitative learning theory: "But you cannot forget that experience is the best way to find out about something. A fellow who takes hold of a bull by the tail once is getting 60 or 70 times as much information as a fellow who hasn't. An' anyone who starts in to carry a cat home . . . ."

from John Reid, a long-ago colleague (of W. S.) at another place, but now and for years at the School of Medicine, University of Missouri; and from our Library and Lister Hill Center colleagues, especially Rick Banvard, Suzanne Merriam, Mike Ackerman, Phil Teigen, and Becky Cagle. In our experience, good help is not at all hard to find.

Finally, we will mention that, about two years ago, in beginning the report that is the model and the immediate ancestor of this one (Seibert, Kuenz, Games, & Gregg, 1987; aka RLT-I, see p. xiii), we recognized the large debt owed to the late Jack Moriarty. We acknowledged then that Jack had been an early and consistent supporter of library trend studies: "His suggestions launched the work [at Purdue] and his support sustained an effort that has outlived him" (p. ix). That debt remains, undiminished. So, to "Mr. M," or Jack, we say thanks again.

W. S., M. K., & P. G.

Preface

The first goal represented here is to complete a fresh and current analysis of the growth (and possibly, of the non-growth) trends in academic research libraries. Such analyses were seen first in the work of Fremont Rider (1940, 1944), then in the nine "Purdue studies" (1965-1973, see Appendix A), in a brief article by Seibert (1985), and most recently in our 1987 Research Library Trends . . . report (hereafter, RLT-I), which also is an update of the Purdue series. But whatever else those studies may have accomplished, the last of them still left many unanswered questions about events and library responses during the 1970's, particularly from 1971 onward, so this study begins as an effort to understand better how libraries responded to the challenges of those, and these, times. We find it difficult to exaggerate the significance of the 100+ academic libraries that are the Association of Research Libraries' core membership, nor of the slightly smaller number that are represented here or in RLT-I. Considered together, they are an annual $1.3 billion enterprise, destined soon to be $2.6 billion, then $5 billion or more, about 18 to 20 years from now. But far more importantly, the resources of these libraries are essential to many thousands of projects and programs that constitute research and scholarship in North America. Their collections mirror and they are mirrored in that research, and the two linked enterprises thrive or they languish together.

Before 1971, research libraries experienced 20 years of unprecedented growth, but the years that followed were marked by severe strains and some reversals. Even though collections continued to grow, their rate of growth declined as the "volumes added" (VA) statistic declined markedly[2]. After two decades in which "VA" had tripled, peaking in 1970 and '71, it declined by 25 percent in the next dozen years, while library staffing showed similar, but more muted signs. Library staffs had also tripled during two decades of growth, but that growth ceased about 1972, and the numbers remained virtually unchanged for almost a dozen years.

Some authors have written of "austerity" and "budget cuts," as if these described or explained what libraries experienced during the '70's (e.g., De Gennaro, 1975; Harvey & Spyers-Duran, 1984), but RLT-I's evidence suggests otherwise. It shows that, except for sluggish growth during 1971 and '72, the 58 libraries' expenditures for materials and for staff, as well as total, increased along the same paths followed earlier, in the growth years (RLT-I, pp. 51, 53). Overall, during the '70's, spending had almost doubled[3], which suggests that inflation was the culprit. But two problems with this are that: 1) consumer price inflation was higher in 1969 and '70, two distinctly "good" years, than in 1971 and '72, the first in the series of "bad" years, and 2) more than half of the libraries' spending was, and typically is, devoted to salaries and wages, which Consumer Price indexing (or CPI) is meant to accommodate. Also, consider this: 3) the prices of library materials, and in particular, of serials, have risen repeatedly in recent years and are sometimes treated as a major, if not the major, factor in the problems that research libraries face, as many recent articles attest (e.g., Winkler, 1983; Dougherty, 1987; Turner, 1987; Hamaker, 1988). Such costs are a problem, certainly, but when were they not a problem and a concern that librarians readily shared? Are we to believe that materials costs were not also a concern in 1960, '65, or '70, when accelerating growth was nearly universal? And besides, materials purchases account for only about one of every three dollars expended (see, e.g., "BKR," Table 4, below)--and serials purchases for one of every five or six--so most library expenditures are exempt from this problem.[4]

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[2] But also, as, or perhaps because, the libraries had built collections that were much larger than before, and in the process, they had become less likely to expand at the rates experienced before.

[3] Average total spending in 1970 and '71 was $3.27M and $3.44M; ten years later, the averages were $6.26M and $6.75M.

From RLT-I's evidence, it is clear that something major began to happen to academic research libraries in the early 1970's. It wasn't austerity, at least not in the sense of a sudden impoverishment; it wasn't budget/expenditure cuts, because those appear rarely in individual library data; and it wasn't inflation, not in any ordinary or usual sense, but whatever it was, it throttled two decades of unprecedented library growth, and it left questions that still need answers.

Another, more limited purpose is to extend the earlier work by examining 35 research libraries not included in RLT-I or in the Purdue studies, and in this way, to see whether those results might have been affected by the nature of the libraries studied, libraries that are, in many or most cases, older, larger, and more established than those included here. On the one hand, substantial effects are considered unlikely because academic research libraries function in similar environments and pursue the same or similar goals. But on the other hand, no one could be sure without examining the evidence.

But above or beyond the more conventional reasons, we also undertook this study because the tools, the help, the data, and a few other resources remained accessible, so the opportunity and the challenge were too good to pass up; in some respects, then, this is another, simpler case of "Once more, unto the breach, dear friends, once more!"

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[4] Note also that extrapolations of RLT-I's results show collections that are now 75 to 80 percent larger than in 1970, staffs that are 15 to 20 percent larger, and spending that is almost 350 percent greater, i.e., almost 4.5 times the 1970 level, but "acquisitions" (more accurately, "volumes added" [Stubbs, 1988]) are about 20 percent below the 1970 level, and a cause for concern, even for pessimism. But against other standards, "VA" has increased. Compared to 1951, "VA" has increased by almost 150 percent, and it is no longer 34 or 35 thousand, as it was then, but is 80 to 85 thousand. Or, compared to 1961, VA has increased by 60 to 70 percent. Perhaps, then, 1970 and the two preceding decades should be remembered as extraordinary times, not to be repeated, rather than as so many segments from many eternally upward-trending curves. Why expect that future collections with three, five--or ten--million volumes will grow five or six percent each year and double in 16 or 17 years, on and on and on? A return to such growth is not impossible, but in recent and foreseeable circumstances, it seems to be.

Introduction

The Introduction to RLT-I (this Preface, p. xiii) presents an extensive review of the library growth literature, a review that is, because of recency and subject matter, as relevant here as it is there. But rather than repeat it here, we will mention some highlights, supplement these with a few additional references and with comment on other growth and trend literature, then include it as Appendix B.

The RLT-I Introduction begins by recognizing the ambivalence that appears repeatedly in library growth literature and cites instances found in the work of Rider; Metcalf; and the Purdue studies of Dunn, et al, as well as some related instances of inconsistency in the work of Axford, Leach, and Molyneux. To make the point, the Introduction's opening words are these:

> If any one thing can be said to characterize the literature on library growth, it is a persistent and sometimes anguished ambivalence, and except for obvious problems, if any one person could be the patron saint of authors in the field, it is "Fiddler's" Tevye of Anatevka. On the one hand, library growth is described as rapid, accelerating, daunting, and destined to remain that way. But on the other hand, authors often recognize the uncertainties that underlie the prediction, so they hedge by noting that indefinite continuation of such growth is impossible, and besides, the statistics used to measure growth are not well defined and hence, their results cannot be trusted (e.g., Piternick, 1977). So, in much of the literature, authors appear to be agreeing and disagreeing with themselves and each other, more or less at the same time (p. 1).

Rider first called attention to the rapid growth of library collections and predicted their exponential doubling, about every sixteen years, but he also doubted the prediction:

> Now, when anything is growing parabolically, there obviously is going to come a time when some sort of impasse begins to impend very rapidly indeed. And it is evident, when one considers the statistics, that American research libraries are fast approaching this particular point in the curve of their history (1944, p. 3).

Or, several pages later:

> Nevertheless, if research librarians were asked categorically whether they thought doubling every sixteen years was going to continue indefinitely, most of them, like the writer, would probably answer 'no' (p. 16).

But then he concluded the chapter with this:

> Librarians and educators cannot look to the outside world for any solution to their problem of research library growth. If they do, they are surely going to be overwhelmed. They must find a solution themselves (p. 19).

Metcalf, on the other hand, had doubts about Rider's dire predictions, and voiced them in his review of Rider's book:

> Mr. Rider . . . has converted many librarians to the thesis that since libraries have been doubling every sixteen years for the past three centuries, there is reason to believe they will continue to do so. The reviewer takes the stand, however, that the turn of the road was reached even before the great depression . . . and that the future growth of our large libraries, taken as a whole, will be more by arithmetical progression than by geometric (1945, p. 170).

But ambivalence was showing a decade later, when he wrote:

> Let me warn you: where Harvard is today in size and costs[5], Yale will be tomorrow, figuratively speaking; California, Chicago, Columbia, Illinois, Michigan, and Minnesota will be there the next day . . . . It may be later than many of us think (1955, p. 118).

Then, another decade passed before the first of the Purdue study series (Dunn, Seibert, & Scheuneman, 1965; see also Appendix A) provided essential confirmation of Rider's main prediction, but not his doubts, or validated Metcalf's warning, but not his stand. The principal finding, repeatedly reconfirmed in eight subsequent updates (e.g., Dunn, Tolliver, & Drake, 1973), was that, on the average, collection growth was following a course that ensured a doubling in seventeen years (e.g., 1965, p. 21; 1973, p. 15), rather than in Rider's sixteen. Still, within the Purdue studies there was ambivalence of two kinds. On the one hand, conservatively:

> It is recognized that no provision is made for an eventual deceleration of growth [and] although some of the [growth predictions], when extended some years beyond 1980, indicate inconceivably [emphasis added] high levels . . .(1965, p. 20)

Or, on the other hand: "There is little basis for expecting an early deceleration in library growth . . ." (1965, p. 20). And this: "Simple arithmetic will lead to the conclusion that [collection size] predictions which are based only on recent [collections] data err in the direction of underestimation" (1965, p. 50).

The studies of Axford, Leach, and Molyneux display something akin to ambivalence that is also something less than obvious. Nevertheless, their words state claims that their evidence does not support. Axford, in "Rider Revisited" (1962), confused the irrelevant statistics of library size with library growth rate when he concluded that Rider was "essentially correct" in emphasizing a relationship between growth rate and educational program quality (p. 347). Piternick (1963) detected the confusion and showed that Axford's conclusion was in error. He showed that there were large positive correlations between library collection size and institutional quality/reputation[6], but no correlation between growth rate and quality (Appendix B, p. 81). Fourteen years later, the abstract of Leach's article (1976) offered three conclusions that challenged those of Rider and Purdue, even though his main text either contradicted the abstract or gave no support to it (Appendix B, p. 83). Still later, Molyneux's two articles (1986a, 1986b) also challenged Rider's and Purdue's main findings, but in the assortment of proffered statistics, both omit crucial (i.e., sequential) collection growth statistics. Instead, both seek to argue their case with invented/hypothetical collection growth statistics; with authentic collection statistics that "span" a single year; and with gross, as well as net "volumes added" statistics that span several years. Absent from both are authentic, generalizable collection statistics that span enough recent years to reveal whether collection growth was on an upward "curvy" path, as Rider and Purdue had found, or wasn't (Appendix B, p. 85).

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[5] At that time, Harvard was reporting collections of about six million volumes and expenditures of $2 million; in 1988, the corresponding numbers were 11.5 million volumes and $37.2 million.

[6] He also warned against assuming or concluding that a correlation between two measures represents causation.

Turning now to the RLT-I report, its findings can be summarized best with excerpts from its Abstract and from the "Amendments" included in its Second Printing. From the Abstract:

> The principal study results describe 35 years of growth and change in library holdings, gross volumes added, professional and nonprofessional staff size, and in three expenditure categories--salaries, materials and binding, and total--as well as university/main campus total and graduate enrollments, and Ph.D. degrees awarded . . . . The trends reflect rapid growth in the libraries' collections, volumes added, expenditures, and staff size from 1951 through 1970 but show different or strikingly different trends, beginning in 1971. For example, between 1951 and 1970, the libraries' "volumes added" tripled (from 34.8 thousand to 107 thousand), then plateaued or declined through 1982 and increased each year since; in 1985, it averaged 93.8 thousand. The libraries' collections . . . appear now to be growing in linear fashion, not parabolically, as before . . . . All three library expenditure categories show large increases--about 22-fold--during the 35-year period, which corresponds to repeated annual increases of about 9%; however, when these increases are re-computed as "constant dollars," they show that growth stopped in 1971 or 1973 and did not begin again until 1982 (p. iii).

And from the Amendments, which include a brief summary of 1951-87 trends in RLT-I's median "composite" institution, aka Thoreau Memorial U.:

> Thoreau's (the median) enrollment increased from 9-10,000 to 24,000+; graduate enrollment from 15-1600 to 4900; annually conferred Ph.D.'s from 64 to 280 (the 1975 peak was 336); library staff from 70 to 240; expenditures from $350,000 to $10.67 million, i.e., 30-fold; and the collection or holdings from 620,000 to 2.6 million volumes (in 1994, 3.1 million are likely). Until 1971, Thoreau prospered, then until 1983 it faltered, but some recent signs suggest recovery (p. iv).

Also, this:

> A central, if not the central, Purdue finding was that research libraries were growing at a rate that would, on the average, double their collections in about 17 years, a rate that of course corresponds also to a quadrupling in 34 years. By coincidence, [RLT-I's] results . . . encompass 34 years of growth and they also show, for eight composite libraries, that when their 1985 collections are stated as multiples of their 1951 collections, they are: 3.65, 4.03, 4.64, 4.34, 2.91, 4.17, 4.06, and 4.88. Coincidence or not, six of the eight composite libraries have been equalling or exceeding a 17-year doubling rate (p. iv).

Because of the sudden interruption in the continued adding of volumes, early in the 1970's, the substantial decline that then followed, and the fragility that this signifies, it has become likely that future collection growth will be slower than Rider or Purdue had found. But even so, the long-term record prior to 1985 still sends echoes of those earlier reports.

Finally, trends described in the literature on libraries "for 2000 A.D." or "of 2001" (e.g., Kemeny, 1962; Lancaster, 1980), libraries "of the future" (e.g., Licklider, 1965, 1982), for the "information age" (e.g., Giuliano, 1979, 1983; Lancaster, 1980), or in the "paperless" society (e.g., Lancaster, 1978, 1985) require some comment, if only to indicate that trends and signs seen elsewhere give much reason to doubt, much less to expect an imminent "electronicization" and a corresponding "de-paperization" of research libraries. For reasons listed below, Aleksander's position, on a closely related issue, is more defensible than those of authors who foresee revolutionary changes that are to be realized early in the coming century. As Aleksander (1987) put it:

> I am worried by a sense of unbridled omnipotence that overtakes some who research into the advancement of information technology and their underestimation of the competence of the human being. There appears to be an unwillingness to show interest in the real limitations of what has been invented and a ready willingness to exaggerate and extrapolate from the sometimes meagre performance . . . achieved with computers, particularly when the human being is taken as a standard (p. 84).

Whatever else may underlie Aleksander's worries, underlying our doubts are these considerations:

1. The assumed economies of systems based on the new technologies are undemonstrated and unlikely to be realized (Baumol & Blackman, 1983; see also Baumol & Marcus, 1973; Martin, 1986[7]).

2. The values, motivations, and rewards that dominate much, if not most, academic behavior and the achievements that define scholarly or research success assign a central, historical, and deeply embedded role to print-on-paper.[8]

3. The integrity of records stored in the new technologies is not guaranteed; records can be altered or destroyed accidentally or intentionally[9], locally or from a distance, immediately or remotely in time.

4. The traditional processes of peer review/quality control are not transferable to the new technologies, and no new, functional equivalents are in sight.

5. The evolution and adoption of the new technologies is affecting practice more slowly than advocates suggest, as shown by libraries' continued spending for materials and binding; e.g., stated as a percentage of total spending in 1951, 1961, 1971, 1981, and 1985, it was 33, 34, 35, 34, and 34 (RLT-I, p. 29). Also, during the mid-80's, spending for automation represented about seven to ten percent of total, at a time when automation had a 25 year history of development, promotion, and application (RLT-I, p. 119; see also Cummings, 1989, p. 5).

6. The utility of the new technologies is limited by the small number of content domains represented, by restrictions based in copyright law, by the size of the audience of skilled users, by "non-friendly" demands imposed on users, by multiple technical incompatibilities, by an inability to accommodate to many needs and formats outside of science and technology (as well as some within), by the limited variety of services the technologies support, and by problems with portability and browsability.

"Forecasting," Baumol has written, "always frightens me, and my standard line is that the one thing about the future that I am sure of is that it will surprise me" (W. J. Baumol, personal communication, May 16, 1988). But a different view, from Licklider, is: "Who can foretell the future, but who does not presume to try?" (1966, p. 1051). Opting firmly for the middle ground, we don't know what the future will bring, but know six substantial reasons why an early arrival of paperless research libraries is practically impossible.

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[7] "No automation project yet has resulted in decreased total cost of library operation." (p. 11)

[8] Proponents of the new technological systems continue to display the same personal reliance on traditional publishing practices that the most visible academics display. When this changes, it will signal a highly significant change in the beliefs that guide their actions.

[9] In spite of extensive safeguards, financial and other institutions continue to be plagued by electronic embezzlement and other tampering. Why, then, expose research literature to the corruption and complications that even a little tampering produces? Once tampering has occurred, there is no way to be sure that the one corrupted record in, say, 1000 will announce its corruption, thus clearing the other 999 of suspicion; if only one is flawed, the 1000 are suspect.

Procedures

Readers familiar with the 1987 RLT-I report or with the much earlier nine-year series of "Purdue studies" (Appendix A) will find that procedures employed here closely follow those of the earlier studies. Here, as before, the annual statistics of a fixed group of academic libraries, members of the Association of Research Libraries (hereafter, ARL), have been expanded by adding statistics that reflect each university's annual total and graduate enrollments, as well as the number of Ph.D.'s and other research doctorates awarded (see definitions in Table 2). And here, as before, the statistics are analyzed to reveal trends; to compare the characteristics of several "composite" libraries, defined primarily in terms of collection size; and to estimate strength of relationship between pairs of statistical variables.

This study differs from its forerunners in two principal respects: It is based on the annual statistics of 35 U. S. and Canadian university libraries (Table 1) that are, with a few exceptions, among ARL's newer, "younger" members[10], rather than older members, as those in the earlier studies were. The 58 older libraries include most charter members of ARL, i.e., members since 1932, plus others admitted to membership before 1963, and in every case, their statistics were available and analyzed back through 1951[11]. In contrast to that, the statistics of the 35 libraries included here all span the years from 1988 back through 1976 (and in 17 cases, through 1969[12]). To achieve the 13 year span, through 1976, 11 current, but recent ARL members were omitted.

Institutional statistics that serve as variables for the study (Table 2) are from five main sources, the first of which is ARL's computerized records of members' statistics. These records, through 1984, were obtained on tape from Kendon Stubbs, University of Virginia, then supplemented and updated with statistics from three sources: published ARL Statistics for 1985 through 1988, reports and records from the National Center for Education Statistics (Appendix C[13]), and from reports compiled by Statistics Canada (Appendix D). The libraries'. . . (continued on p. 13)

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[10] Most of the 35 libraries became ARL members between 1967 and 1976 (Table 1) and some, in fact, were not established, at least not in present form, until the 1950's or perhaps later (e.g., SUNY-Stony Brook; U. of California, Santa Barbara).

[11] The 93 libraries represented here or in RLT-I (and in the Purdue studies) include all but one of ARL's pre-1979 members. Brigham Young U. is the exception, a member since 1974, but omitted here because some needed data were unavailable. (Some "older" members were similarly omitted from the Purdue studies [Dunn et al, 1965, p. 57]).

[12] This subset of 17 cases, dubbed the "OLD" libraries, is valuable because their data permit analyses of trends just before, as well as after, 1971, the year that RLT-I has shown to be a major "watershed," i.e., a year that separates two decades of prosperity and growth from a decade or more of struggle.

[13] A similar, but more extensive listing of NCES sources is presented as Appendix B of the RLT-I report, pp. 133-140.

Procedures in Brief

Briefly stated, the study procedures are the following: The annual statistics of member libraries were obtained from ARL, and the statistics of 35 members, through 1984, were copied from the computer tape provided. Then, for later years, through 1988, the corresponding statistics were recorded from published ARL Statistics. Enrollment and Ph.D. award statistics for the 28 U. S. universities came primarily from NCES reports, listings, or staff files, and the corresponding Canadian institutions' statistics came either from reports supplied by Statistics Canada or from the seven campuses.

Repeated reviews of the accumulating statistics revealed that perhaps 5-8 percent of the data cells either had no entry or contained a questionable entry, and these were dealt with by several means: by re-checking original sources, by searching other sources, by asking individuals at the institutions to review and verify entries, and as a last resort, by entering an interpolated value. The completed file includes about 7750 entries, of which, half of one percent are interpolations.

As in RLT-I and the Purdue studies, to trace trends over time, several composite libraries were defined and their statistics were then followed. The seven defined and employed here represent: 1) annual means (averages) based on data from all 35 libraries, 1976-1988; 2) medians based on the same data; 3) means for 17 "old" libraries with data that extend from 1969 through 1988; 4) medians based on the same 17, also 1969-1988; 5, 6, and 7) means for three size groups, Large, Mid, and Small, with groupings based on 1987 collection size[14]; as in 1 and 2, above, their data extend from 1976 through 1988 (and their n's = 12, 11, and 12). Data were analyzed with SAS statistical software.

The 35 libraries are listed in Table 1, the study variables are defined in Tables 2 and 2a, and the seven composite libraries are defined in Tables 3 and 3'.

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[14] The groupings are of course somewhat arbitrary, just as distinctions between A- and B+ ades can be. This is particularly true of the decision that serves to separate the lower end the Mid-size group from the upper end of the Small, a decision that "draws a line" between raries with 1987 collections above or below 1.62 million volumes.

Table 1

Names, Identification Numbers*, and Year of Entry into ARL Membership for the 35 Academic Libraries

101 Alabama (1967)

102 Alberta (Can., 1968)

103 Arizona (1967)

104 Arizona State (1973)

106 British Columbia (Can., 1967)

107 California, Davis (1968)

108 California, San Diego (1973)

109 California, Santa Barbara (1973)

110 Case Western Reserve (1968)

111 Colorado State (1975)

112 Connecticut (1962)

113 Dartmouth (1932)

114 Emory (1975)

115 Georgetown (1962)

116 Georgia (1967)

117 Hawaii (1976)

118 Houston (1975)

119 Howard (1971)

120 Kent State (1974)

121 Massachusetts (1968)

122 McGill (Can., 1932)

123 McMaster (Can., 1976)

124 Miami, U. of (1976)

125 Oklahoma State (1962)

126 Queen's (Can., 1976)

127 Rice (1971)

129 South Carolina (1975)

130 Southern Illinois (1967)

131 SUNY-Albany (1975)

132 SUNY-Buffalo (1967)

133 SUNY-Stony Brook (1975)

134 Toronto (Can., 1932)

135 Tulane (1967)

136 Virginia Polytechnic & State U. (1976)

137 Western Ontario (Can., 1976)

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* Note that there is no #105 or #128.

Table 2

Thirteen Principal Statistical Variables: Names, Abbreviated Names, and Brief Definitions*

Variable Name	Abbrev.	Brief Definition
Volumes Held	VH	Number of volumes held in the library collection.
Volumes Added	VA	Number of (gross) volumes added to the collection.
Current serials	CURSER	Total number of current serials received.
Microforms Held	MFLM	Number of microform units (-film, -cards, -prints, -fiche) held in the collection.
Total Expenditures	TX	Total operating expenditures (US$), including BX, SX, and "other" operating expenditures.
Salary-Wage Expenditures	SX	Expenditures (US$) for salaried library staff, student wages, "other" personnel; excludes fringe benefits.
Book, Periodical & Binding Expenditures	BX	Expenditures (US$) to acquire books, periodicals, and other library materials, and for binding.
Entering Professional Salary	LPSP	Annual salary paid (US$) or that would be paid to an entering professional librarian.
Professional Staff Size	PSS	Number of professional staff, full-time equivalents (FTE).
Nonprofessional Staff Size	NPSS	Number of nonprofessional staff, full-time equivalents (FTE).
Total Student Enrollment	TENR	Total number of students enrolled in degree-credit programs, fall term/semester.
Graduate Enrollment	GENR	Number of students enrolled for advanced/graduate degrees, fall term/semester; does not include "first professional" degree students in medicine, law, etc.
Ph.D. Degrees	PHD	Number of Ph.D. and other research doctorates awarded (Ed.D., D.B.A., etc); does not include "first professional" doctorates in medicine, law, etc.

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* The first ten variables are defined in Stubbs and Buxton (1981). The others are based on enrollment and "earned degree" reports of the National Center for Education Statistics (Appendix C) or similar reports from Statistics Canada (Appendix D).

Table 2a

Eleven Supplementary Variables/Ratios: Names, Abbreviated Names, and Brief Definitions

Variable Name	Abbrev.	Brief Definition
Percentage Increase	PINC	Volumes added (VA) divided by volumes held (VH).
Salary-wage Expenditure Ratio	SALR	Salary expenditures (SX) divided by total operating expenditures.
Materials Expenditure Ratio	BKR	Materials and binding expenditures (BX) divided by total operating expenditures (TX).
Ratio of Materials Cost to Volumes Added	BXPVA	Materials and binding expenditures (BX) divided by volumes added (VA).
Nonprofessional to Professional Staff Ratio	NPSR	Nonprofessional staff size (NPSS) divided by professional by professional staff size (PSS).
Cost/expenditures per Student Enrolled	CXPS	Total operating expenditures (TX) divided by total enrollment (TENR).
Graduate Student Ratio	GRDR	Graduate enrollment (GENR) divided by total enrollment (TENR).
Ratio of Ph.D.'s Awarded to Graduate Students Enrolled	PHDR	Ph.D.'s (PHD) divided by graduate enrollment (GENR).
Volumes Held per Student Enrolled	VHPS	Volumes held (VH) divided by total enrollment (TENR).
Volumes Held per Graduate Student	VHPG	Volumes held (VH) divided by graduate enrollment (GENR).
Volumes Added per Graduate Student	VAPG	Volumes added (VA) divided by graduate enrollment (GENR).

Table 3

The First Four (of Seven) Composite Libraries: Names, Abbrev. Names, and Defining Features

Composite's Name	Abbrev.	Defining Features
Average	Av	Each annual statistic of the 35 libraries was averaged for each year, 1975-76 through 1987-88. This composite is composed of the average values calculated for each year.
Median	Mdn	Each annual statistic of the 35 libraries was rank-ordered each year, 1975-76 through 1987-88. This composite has statistics that place it midway in the ranks; it is the hypothetical 50th percentile library.
Average-OLD	Av-O	This composite consists of averages calculated for the 17 "old" libraries with data that extend back through 1968-69.
Median-OLD	Mdn-O	This composite consists of medians calculated for the 17 "old" libraries with data that extend back through 1968-69.

Table 3'

The Last Three (of Seven) Composite Libraries: Names, Abbrev. Names, and Defining Features

Composite's Name	Abbrev.	Defining Features
Large*	Lge	The 35 libraries' reported collections for 1986-87 are the basis for defining this composite (and the two that follow). For this composite, the 12 libraries with the largest collections were identified, then their average characteristics were calculated for each year.
Mid-size*	Mid	This composite is defined in essentially the same way as the Lge, above, except that it is based on averages for the 11 libraries with 1986-87 collections just smaller than those of the 12 largest.
Small*	Sml	This composite consists of averages calculated for the 12 libraries that had the smallest collections in 1986-87.

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* The 12 "large" libraries are Alberta, Arizona, Arizona State, British Columbia, California at Davis, Georgia, Hawaii, Massachusetts, McGill, South Carolina, SUNY at Buffalo, and Toronto.

* The 11 "mid-size" libraries are Alabama, California at San Diego, California at Santa Barbara, Connecticut, Dartmouth, Emory, Kent State, Queens, Southern Illinois, Tulane, and Western Ontario.

* The 12 "small" libraries are Case Western Reserve, Colorado State, Georgetown, Houston, Howard, McMaster, Miami, Oklahoma State, Rice, SUNY at Albany, SUNY at Stony Brook, and Virginia Polytechnic & State U.

1985-1988 collection, personnel, and expenditure statistics were obtained from the four most recent ARL reports; the 28 U. S. institutions' annual total and graduate enrollments and their Ph.D. award statistics were obtained from NCES; and the corresponding statistics of the seven Canadian institutions were obtained either from Statistics Canada in Ottawa or from libraries or other offices at each institution. Finally, statistics that comprise the variable dubbed "LPSP," i.e., entering professional salary (Table 2), are from ARL's Annual Salary Survey reports, compiled in recent years by Gordon Fretwell (e.g., ARL, 1986).

It is an open secret that the statistics of universities and libraries are not of reagent quality. In some degree, they are contaminated and in ways that cannot be fully described. So, to minimize such contamination, the accumulating records were reviewed repeatedly, searched for voids and inconsistencies, and marked as found. (An estimated 5-8 percent of the entries revealed some problem.) Then, to resolve the problems, we normally turned first to reports or records from ARL, the National Center for Education Statistics, or Statistics Canada, then to ARL or NCES staff, and finally to the libraries', registrars', or graduate school offices at the 35 institutions. If or when these efforts failed, we calculated and entered an interpolated value; in all, 39 entries, or one-half of one percent of the total, are interpolations.

Problems of another kind are represented in expenditure statistics from the seven Canadian libraries. Until 1980, ARL's Canadian members reported expenditures in local dollars, but since then, they have reported both in local and in equivalent U. S. dollars (Appendix E). So, for the analyses summarized in the "Results" below, the seven Canadian libraries' expenditures are expressed in U. S. dollars,[15] thus "solving" problems that arise from a changing exchange rate, but creating others. For example, the conversion of entering professional salaries paid to librarians in Edmonton or Montreal into U. S. dollars is hardly a perfect solution. The converted sums can be merged with the U. S. data, then handled statistically, as needed, but they have almost nothing to do with the lives of young Canadian librarians who earned and who presumably spent the money. Similarly, conversion of the Canadian libraries' salary and wage expenditures, the element that dominates library expenditures, not only into U. S. dollars, but for some purposes, into "constant," inflation-adjusted U. S. dollars, compounds the problem. Nevertheless, the conversions were done because the alternatives were less appealing, besides which, their presence in the data provides a further reminder not to interpret results recklessly.

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[15] Readers interested in the Canadian libraries' trends will find that Appendix F summarizes the seven libraries' averages on several selected variables, including total, salary-wage, and materials-binding expenditures; entering professional salary; expenditures per enrolled student; and some others. All expenditure-based averages are reported in Canadian dollars.

Results

A guide, "map," or plan will help readers make sense out of the eight tables and 20 figures that appear later in this section or in Appendix G[16], whose contents summarize the study's principal results. They summarize results for the four composite libraries defined in Table 3, plus the additional three defined in Table 3', in combination with the 24 variables defined in Tables 2 and 2a. Note also that the tabular and figural contents overlap, that each figure presents selected results that are also reported numerically in two or more of the tables[17]. Correlations between pairs of variables were calculated for each year, 1976 through 1988, and these are summarized in Table 11, which reports the highest, median, and lowest correlation between each variable pair.

To begin, once the reader has some sense of the contents of Table 3 and 3', i.e., of how the four-plus-three composite libraries are defined, and some sense also of the variables defined in Tables 2 and 2a, e.g., VH = volumes held, TX = total operating expenditures, TENR = total enrollment, and BKR = proportion of total that is spent for materials and binding, it will be helpful to examine Figs. 1 through 6, figures that describe the shape and nature of trends that are associated with collection growth, volumes added, expenditures, and staff size.

When examining the figures and tables, several questions worth considering are:

1. For VH (volumes held), especially during the last decade or more, does collection growth follow an upward curving line, as Rider and Purdue both found; an approximately straight line, as RLT-I tends to show; a weakening curve; or a mixed trend? And about how many years are required for VH to double[18]?

2. For VA(volumes added), what increases or decreases are there? In particular, what shifts occur in or near 1971, 1983, and 1985? Also, is the recent trend upward or down?

3. For TX (total operating expenditures), is there any year when TX declines, and about how many years are required for TX to double?

4. For SX (salary-wage expenditures), is there any year when SX declines, and about how many years are required for SX to double? Also, for SALR (proportion of total expenditures devoted to SX), does the proportion increase or decrease over time?

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[16] The three tables (nos. 8, 9, and 10) and six figures (nos. 13 through 18) that summarize results for the Large, Mid-size, and Small composite libraries are included in Appendix G, rather than in the main body of the report. Their contributions are modest, so their inclusion in the main text seems unwarranted.

[17] Figs. 1-6 present selected results from Tables 4 and 6, Figs. 7-12 present results from Tables 5 and 7, and Figs. 13-18 (Appendix G) present results from Tables 8, 9, and 10 (ditto). Also, Figs. 19 and 19a present expenditure trends from Tables 4 and 6, respectively, reported both as "actual $" and as inflation-adjusted "constant $" (Appendix H).

[18] The "rule of 72" is that a statistic's doubling rate times its percent of annual increase equals (approx.) 72. Thus, if VH increases at the rate of 3% per year, 72/3 = (approx.) 24 years to double.

5. For BX (materials and binding expenditures), is there any year (e.g., 1971) when BX declines, and about how many years are required for BX to double? Also, for BKR (proportion of total expenditures devoted to BX), does the proportion increase or decrease over time?

6. For PSS (professional . . .) and NPSS (nonprofessional staff size), do the numbers increase over time, particularly during the last several years? Also, does NPSR (ratio of nonprofessional to professional staff) change "significantly?"

7. For CURSER (number of current serials the library receives), what is the shape of the trend, and how does it compare with the trend of VA?

8. For TENR (total enrollment) and GENR (graduate enrollment), are there "significant" increases in the numbers? Also, has GRDR (ratio of graduate to total enrollment) changed "significantly" over time?

9. For PHD (number of research doctorates awarded), are there "significant" changes over time?[19]

10. For CXPS (library expenditures per enrolled student), how rapidly do these expenditures increase; and about how many years are required for CXPS to double?

The other study variables, primarily the additional ratios identified in Table 2a, may seem peripheral or too specialized, although "PINC" is a likely exception. It is defined as gross volumes added (VA) divided by volumes held (VH) and it serves to approximate the collection growth rate, while also overstating it somewhat. Still, PINC monitors growth and it is expected to show, as in RLT-I[20], that in any given year, smaller collections will tend to be associated with larger PINC's and vice versa. And across the years, as all collections grow, PINC will tend to decline. Furthermore, to the extent that these tendencies continue, doubling intervals will continue to lengthen beyond the 16 or 17 years described by Rider or Purdue or the longer intervals that RLT-I's recent evidence suggests (pp. 116-117), to still longer intervals, and it is conceivable that, a dozen years from now, around the year 2000, doubling intervals that exceed 25 years will become common.

Figures 19 and 19a represent another kind of special case, since each figure traces the libraries' annual total, salaries, and materials expenditures (i.e., TX, SX, and BX) both as actual, average dollars expended and as constant, inflation-adjusted averages. Fig. 19 is based on data from all 35 libraries, 1976 through 1988, while Fig. 19a is based only on the 17 libraries with data from 1969 through 1988. For the SX averages, constant dollar adjustments use a multiplier derived from the Consumer-Price Index (CPI), and for TX and BX averages, a Gross National Product (GNP) index is used (Appendix H). These are meant to follow preferred practice among economists, but it is worth noting also that discrepancies between the CPI and GNP indexes are small, as columns 3 and 5 of Appendix H show, so their multiplier effects are similar.

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[19] In the U. S., the peak year for awarding research doctorates was 1973, when 34,777 were awarded, and in the most recent year for which data are available, 1987, 34,120 were awarded. In the years between, 1978 had the smallest number of awards, 32,131.

[20] Where the median correlation between PINC and VH is about -.40.

A Cautionary Note About Averages and Medians

The composite libraries included here are based either on averages or on medians, and both measures of central tendency have been included because large variability in size, as among the libraries studied, can distort or skew averages, but not medians. In 1988, e.g., the largest library's collection was five times that of the smallest, and 1.7 times that of the second-largest, and its expenditures were 4.2 times those of the smallest. With this variation, averages become skewed upward (for the same reason that, if several librarians' annual income were added to Mr. Lee Iacocca's, then averaged, the result would be skewed). But medians are unaffected by one or a few extreme values, so in the same unreal example, the median income would be that of the librarian who ranks in the middle. (If we assume nine people in all then it's the income of whoever ranks fifth. Furthermore, her salary would still define the median, even if a couple of the librarians were unemployed).

The problem with medians is that they are relatively unstable, particularly when the number of analyzed cases is fairly small, as it is here--and in the example above. The instability is hard to detect in Tables 5 and 7, but is more visible in the figures and seems most visible when Fig. 8 (medians) is compared with Fig. 2 (averages); Fig. 8 reports that "volumes added" increased in 1988, Fig. 2 says otherwise. "Otherwise" is more credible.

Results, Considered One Variable at a Time[21]

Volumes Held (VH). Since 1976, if not before, collection growth has followed an essentially linear trend, as can be seen in Figs. 1 and 7, and since '76, average VH has increased from 1.37 million volumes to 2.04 million (Table 4), or since '69, the average VH of the 17 older libraries has increased from 1.13 million to 2.39 million (Table 6), i.e., their collections had slightly more than doubled during 19 years of growth. And as expected, the median trends of Fig. 7 are less consistent than those of Fig. 1, although both figures describe similar patterns of growth. Fig. 7 also shows that the median VH doubled in something more than 17 years. From 1971 through 1988, the median increased from 1.12 million volumes to 2.23 million (Table 7). Nevertheless, PINC, the barometer of collection growth rate, has dropped steadily, as Tables 4 through 10 show, and this suggests that future rates and future doubling intervals will be lower and longer than ever.

Volumes Added (VA). In the years before 1982, VA declined regularly and sharply, eventually losing about 30 percent of its initial level (Table 6, see also Fig. 2 and Table 4), then recovering part of that loss during the next three years, before declining again through 1988. The plotted medians in Fig. 8 have similar trends: There, VA drops sharply until the early '80's, recovers some through 1985, then experiences a mixed loss and recovery from 1986 through 1988. However, as indicated earlier, medians, and in particular the apparent 1988 recovery they describe in Fig. 8, are questionable because the inherently more stable means of Fig. 2 (or Tables 4 and 6) tell a very different and more credible story.

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[21] Note that Tables 4 through 7 include data on all 24 variables that are defined in Tables 2 and 2a, not just the few that are mentioned below. But in the interests of space and reader patience, we will concentrate on results seen in Tables 4 and 6 and Figs. 1-6, 19, and 19a, where a majority of the more important trends are found.

Total Operating Expenditures (TX). The parallel plots in Fig. 3 show two series of annual spending increases (see also Tables 4 and 6), both with doubling intervals of about nine years, so the average annual increases are about 8 percent. The fairly smooth shape of the plotted points also indicates that most of the increases--there are no decreases--are close to the norm. The median plots of Fig. 9 resemble the averages seen in Fig. 3, although the Median-OLD plot (Fig.9) also shows that TX decreased both in 1972 and 1980 (Table 7), but again, since the stronger evidence provided by means disputes this, some discounting of the less stable medians is justified. Note also that, between 1969 and '88, TX increased from about $2.5 to $10.4 million, or 314 percent. Inflation is of course the major factor in these increases, although it also appears that, each year since 1980, the constant $ TX averages (Figs. 19 and 19a) increased substantially. In Fig. 19, which represents data from all 35 libraries, the increase is from about $7 to $9.3 million, and in Fig. 19a, with data from the 17 older libraries, it is from $8 to $10.4 million.

Salary-Wage Expenditures (SX). Findings from RLT-I and elsewhere have shown that salary and wage expenditures account usually for a generous half of total spending, i.e., SX = approx. .55TX (RLT-I, p. 29). Stated differently, SALR = approx. .55. With experience as a guide, SX here was expected to maintain increases that were generally parallel to the TX trends just described, but at just over half of the TX level, and in fact, it does. Note, for example, that the Average-OLD SX plot in Fig. 4 begins at the level of $1.32 million in 1969 and ends at $5.61 million in 1988; in both years--but not in the years between--SALR = .52 (Table 6). Similarly, the corresponding SALR averages for the 35 libraries are .56 in 1976 and .51 in 1988. But note also that when SX and TX are converted to constant dollars (Figs. 19 and 19a), their trends are only faintly similar, not parallel. From about 1976 or '77 until 1980, SX declines, then it increases through 1988, as TX does also; however, unlike TX, the 1988 SX level is only slightly above that of 1976 or '77, i.e., as Fig. 19 shows, between 1977 and '88, the constant $ SX only increased from $4.6 million to $4.9 million, and in 19a, the corresponding increase was from $5.3 to $5.6 million.[22]

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[22] To estimate library staff purchasing power over the years, we first divided the annual staff totals (PSS + NPSS, Table 6) into the salary-wage expenditures (SX) to get an approximate average salary, then multiplied that by an annual CPI factor from column 3, Appendix G, to get a "constant $" average. The results are simple estimates, and the procedures ignore--or treat as an annual constant--any SX funds that were paid as hourly wages; in the process, they also inflate the averages somewhat, but for readers who can tolerate the assumptions that the procedures entail, what was found is that, in 1969, the "constant $" average was $19728; this increased to $23633 in 1977, decreased to $19979 in 1980, and increased again through 1988, ending at $23292. The "best" years were 1977 and 1988; the "worst" were 1969 and 1980.

Materials-Binding Expenditures (BX). Findings from RLT-I and elsewhere also show that spending for materials and binding accounts usually for about one-third of total spending, i.e., BX = approx. .33TX (e.g., RLT-I, p. 29). Another way to say the same thing is BKR = approx. .33. So, with experience as a guide, BX here was expected to maintain increases that were generally parallel to the TX trends already described, but at about a third of the TX level. To test this, review the record of the BKR variable in any table or compare the TX and BX plots in Figs. 3 and 5. These will show that in recent years BKR has changed little, thus BX has paralleled TX during those years, but the record also shows that BX fared less well from 1969 until about 1979. Note that its slope or angle in Fig. 5 is relatively flat during the early years, but that the corresponding TX slope in Fig. 3 is not. Note also that BKR declines from .40 in 1969 to .34 in 1978, stabilizes at about .35, and ends finally at .37 (Table 6). Further confirmation found also in Table 6 is that, while TX increased 314 percent (from $2.507 to $10.378 million), BX increased only 269 percent (from $.993 million to $3.66 million). Finally, the constant $ BX plots in Figs. 19 and 19a indicate that expenditures for materials and binding did not keep pace with inflation--as measured by the GNP index--until sometime in the late 1970's and that gains since then have been modest. In Fig. 19a, for example, constant $ BX declines from a 1969 level of about $3.04 million to a 1978 level of $2.55 million, then increases gradually to a 1988 level of $3.66 million; over the full 20 year period, the net increase--as measured--is about 20 percent.

Professional (PSS) and Nonprofessional Staff Size (NPSS). Results that describe changes in staff size are presented in Figs. 6, 12, and 18 and in Tables 4 through 10 and all tend to show that professional staff f.t.e.'s had no pronounced trend until about 1980, and that they then increased gradually through 1988 (e.g., Fig. 6). The trend for nonprofessionals is similar, except that the gradual increases began four or five years later. Between 1976 and 1988, professional f.t.e.'s increased from 59 to 66 and nonprofessionals from 140 to 146 (Table 4), and NPSR, i.e., the ratio of nonprofessionals to professionals, is about 2.2 or 2.3 to 1, which almost certainly is a residual or a by-product of the rapid library growth and the accompanying recruiting pressures that were found during the 1950's and '60's (RLT-I, p. 112)[23].

Current Serials (CURSER). The CURSER trends found here seem not to be strong or pronounced, although over the thirteen years recorded in Table 4, the average CURSER increased from 17807 to 21560, or 21 percent. But on the other hand, CURSER's peak year was not 1988, but 1985 (and it is worth noting that VA had the same peak year), when CURSER averaged 22161, a scant few percentage points higher than the 1988 level. It should also be noted that CURSER is a variable with a somewhat checkered past (Stubbs and Buxton, 1981, p. ix), so it should probably be handled with care.

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[23] Findings from RLT-I (e.g., pp. 29, 112) show that, in 1951, the ratio was almost 1 to 1, but that it became almost 2 to 1 by the end of 1970; this change occurred during the time when total staff numbers were increasing by a factor of 2.6.

Total (TENR) and Graduate Enrollment (GENR). Tables 4 and 6 provide the two best summaries of campus enrollment, and both record a series of significant increases, particularly in graduate enrollment. Table 4 reports that average total enrollment in 1976 was 18824 and that this increased to 20692 in 1988, representing an increase of 9.9 percent, and Table 6, with data that span 20 years, beginning in 1969, TENR in the initial year is 16217 and it increases to 22433 in the last year, an increase of 38.3 percent. In the same two tables, the corresponding graduate enrollment averages are 3317 and 4130 (Table 4), an increase of 24.5 percent, and 2847 and 4470 (Table 6), for an increase of 57 percent. The ratio of GENR and TENR, called GRDR, usually ranges between about .17 and .20, and its trend is generally and gently upward. For example, Table 4 reports the 1976, 1982, and 1988 ratios to be .18, .18, and .21, while Table 6 reports .17, .19, and .21 for the same three years.

Research Doctorates Awarded (PHD). Table 4 shows the average number of awarded doctorates increasing from 153 in 1976 to 166 in 1988, an increase of 8.5 percent, while Table 6 shows averages that increase from 136 in 1969 to 192 in 1988, an increase of 41 percent. In both tables, the averages tend to decline until 1980 or '81 and to increase afterwards. Also, the ratio between the number of doctorates awarded and the number of graduate students enrolled, called PHDR, is declining noticeably. In Table 4, the PHDR average for 1976, 1982, and 1988 are .052, .046, and .043, while the corresponding averages in Table 6 are .056, .046, and .043. Obviously, the declining PHDR ratio, in company with increasing Ph.D. awards indicates that graduate enrollment has been increasing rapidly.

Library Expenditures per Enrolled Student (CXPS). In the 13 years that are represented in Table 4, 1976 through 1988, CXPS more than doubles, increasing from $235.27 to $540.89. Also, in an effort to adjust for inflation's effects, the 1976 CXPS was multiplied by the GNP-based index for that year (Appendix H, Column 5), and the result was that the 1976 CXPS, stated in constant 1988 dollars, was $453.84. When this is compared to the actual 1988 CXPS of $540.89, it shows an increase of about 19 percent. The CXPS averages reported in Table 6 increase from a 1969 level of $165.29 to a 1988 level of $541.26, which is an increase of 227 percent, but when adjusted for inflation, the 1969 average is $505.46, and the increase during 19 years of growth is about seven percent.

Four Other Ratio Variables (BXPVA), (VHPS), (VHPG), and (VAPG). The BXPVA variable is defined, as its name suggests, by dividing VA into BX and it is, therefore, a measure sensitive to materials price inflation. It is not, of course, an ideal measure of per-volume costs, and it may understate or overstate actual costs.[24] Nevertheless, its increases are . . . (continued on p. 62)

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[24] BXPVA is defined "as if" all BX expenditures contributed to the prompt adding of volumes, and thus it ignores the microforms, software, recordings, maps, etc. that are also purchased. It also ignores the fact that some volumes are not added "promptly," that some are not purchased, and that a (small) portion of BX is spent on contract binding.

Table 4

The Average (Av) ARL Library, 1976-1988 (n = 35)

YEAR	VH	VA	BX	SX	TX	LPSP	PSS	NPSS	MFLM	CURSER	TENR	GENR	PHD
1976	1373485	76693	1323308	2173223	3773272	10320	59	140	849291	17807	18824	3317	153
1977	1419740	71121	1334010	2337805	3997237	10940	59	139	925408	17225	18799	3241	150
1978	1478083	68876	1404871	2461780	4240853	11120	60	142	1006480	17853	18454	3326	147
1979	1520875	67505	1574745	2619474	4575500	11588	60	140	1115336	17818	18573	3373	145
1980	1580069	63967	1715113	2821799	4953558	12359	60	141	1226563	19079	18772	3391	143
1981	1639205	62521	1945707	3151750	5560543	13554	60	140	1344609	19533	19280	3456	146
1982	1706210	64241	2130704	3450096	6169484	14426	61	143	1476062	20299	19717	3500	148
1983	1762634	67034	2279739	3623819	6583839	14803	61	140	1604711	20845	20007	3560	149
1984	1822592	66817	2459002	3844900	7073141	15509	62	141	1749296	21579	20117	3625	149
1985	1887951	70866	2585630	3992396	7549154	16821	63	141	1904310	22161	20002	3614	151
1986	1933163	66362	2828508	4219263	7988338	17845	64	142	1748805	21469	19984	3670	157
1987	1991989	65841	3149999	4495748	8588887	19827	65	143	1829915	21600	20230	4009	161
1988	2036287	63249	3415685	4890461	9330282	20098	66	146	2011550	21560	20692	4130	166

	PINC	SALR	BKR	BXPVA	NPSR	CXPS	GRDR	PHDR	VHPS	VHPG	VAPG
1976	.056	.560	.363	18.24	2.29	235.27	.18	.052	89	541	30.6
1977	.050	.565	.354	19.90	2.31	240.81	.17	.051	92	569	25.7
1978	.046	.564	.347	22.02	2.34	264.62	.18	.049	96	565	23.7
1979	.044	.560	.355	24.91	2.29	284.11	.18	.048	98	586	24.7
1980	.052	.555	.358	28.18	2.31	310.47	.18	.046	99	566	22.7
1981	.038	.553	.361	33.64	2.29	341.55	.18	.047	103	601	21.9
1982	.037	.545	.356	35.73	2.32	368.73	.18	.046	104	600	21.3
1983	.038	.538	.359	35.85	2.25	391.80	.18	.046	106	617	22.8
1984	.036	.532	.357	38.68	2.24	419.83	.18	.046	108	621	22.5
1985	.037	.520	.353	38.77	2.22	451.27	.18	.046	113	648	24.0
1986	.034	.519	.360	45.56	2.19	482.88	.19	.047	116	649	21.5
1987	.033	.515	.375	50.31	2.21	507.20	.20	.044	117	612	20.5
1988	.031	.513	.376	59.35	2.18	540.89	.21	.043	117	606	18.8

Table 5

The Median (Mdn) ARL Library, 1976-1988 (n = 35)

YEAR	VH	VA	BX	SX	TX	LPSP	PSS	NPSS	MFLM	CURSER	TENR	GENR	PHD
1976	1227596	65377	1181751	1744600	3307232	10342	54	105	838725	14931	19882	2820	146
1977	1274151	65000	1219691	1836501	3456368	10550	54	106	910831	15406	20185	2920	149
1978	1308725	64191	1370273	2046857	3722842	10800	55	108	977607	16420	19737	2974	138
1979	1342878	59787	1602642	2282155	4028960	11200	55	110	1041301	16674	18582	3073	144
1980	1375565	56036	1599403	2340725	4370332	12000	55	111	1148925	16781	18255	3151	144
1981	1426747	54407	1869452	2640566	4620524	13000	55	115	1232621	16641	18886	3055	142
1982	1473308	54944	1847271	2774418	5154149	13800	54	114	1379146	17283	19674	3093	139
1983	1516998	61291	2133386	3219864	5697201	14000	56	114	1536824	18263	19927	3183	142
1984	1559141	62829	2333900	3402234	6234637	14895	58	115	1779160	19101	20065	3177	145
1985	1651771	64069	2582196	3560520	6554564	16300	57	117	1993180	19000	19964	3166	146
1986	1745803	61973	2669137	3747512	6875415	17000	60	116	1677205	19814	19835	3199	157
1987	1806039	58869	2907321	4293963	7921184	19500	59	122	1741570	20040	19809	3730	158
1988	1786394	59329	3245934	4609996	8368445	19556	62	123	2014484	18534	20847	3881	168

YEAR	PINC	SALR	BKR	BXPVA	NPSR	CXPS	GRDR	PHDR	VHPS	VHPG	VAPG
1976	.054	.574	.349	17.07	2.07	222.28	.17	.050	70	445	22.5
1977	.051	.574	.333	19.38	2.21	211.50	.16	.045	73	478	22.8
1978	.047	.563	.335	21.56	2.16	227.94	.17	.046	77	485	20.9
1979	.043	.558	.341	24.84	2.16	270.91	.17	.046	82	494	21.8
1980	.039	.563	.355	28.42	2.20	276.90	.17	.043	84	512	20.3
1981	.036	.548	.359	34.48	2.06	295.62	.17	.043	88	506	17.0
1982	.037	.550	.356	36.35	2.06	328.54	.17	.045	89	529	18.9
1983	.036	.530	.348	36.22	2.09	335.18	.17	.041	93	541	18.3
1984	.036	.523	.360	38.15	2.03	356.66	.17	.040	95	584	22.0
1985	.035	.517	.362	38.66	2.09	366.02	.17	.041	100	604	21.7
1986	.034	.514	.354	46.05	2.00	381.08	.17	.044	102	599	17.8
1987	.032	.522	.366	50.56	2.04	412.83	.19	.044	102	601	18.9
1988	.031	.507	.379	57.92	2.00	438.23	.20	.042	101	565	17.0

Table 6

The Average-OLD (Av-O) ARL Library, 1969-1988 (n = 17)

YEAR	VH	VA	BX	SX	TX	LPSP	PSS	NPSS	MFLM	CURSER	TENR	GENR	PHD
1969	1129039	104392	993093	1324159	2507281	7002	68	149	337466	N/A	16217	2847	136
1970	1224225	101210	1012607	1503472	2734596	7338	72	161	403579	N/A	17796	3071	164
1971	1274925	101429	1045623	1582479	2874457	7796	70	163	482133	N/A	17405	2936	192
1972	1364366	97165	1057224	1784479	3071710	8103	73	156	548811	15229	18128	3051	189
1973	1443811	91224	1112179	1907061	3267176	8438	71	162	618960	16924	18586	3247	201
1974	1516587	81107	1174863	2104293	3510512	8785	73	159	710738	18881	18826	3275	199
1975	1588343	80987	1229354	2340625	3879588	9364	71	166	788718	19551	19418	3291	189
1976	1629499	79959	1389866	2583549	4323769	10179	70	168	850168	20168	20345	3408	188
1977	1663692	75670	1430041	2746211	4550909	10748	68	159	913028	19195	20222	3371	177
1978	1737720	75048	1511387	2892025	4829430	11003	69	163	989611	19615	20056	3498	182
1979	1790293	75966	1723239	3051064	5191494	11412	68	161	1110824	19933	20075	3572	176
1980	1850636	72060	1867840	3279158	5613981	12088	70	166	1239999	21240	20467	3612	173
1981	1915320	71420	2114095	3636139	6232554	13480	70	160	1397256	21864	20982	3725	177
1982	2000104	75767	2293173	3915832	6837812	14240	72	164	1545557	22742	21620	3804	174
1983	2053041	75669	2469955	4219262	7364453	14705	71	158	1649111	23200	21693	3917	177
1984	2119825	74883	2599794	4417489	7711394	15358	71	158	1768308	23972	21808	3971	176
1985	2191318	80448	2756810	4621313	8320264	16777	73	159	1933442	24561	21633	3936	182
1986	2255574	74888	3017408	4766433	8772998	17341	74	160	1838942	24379	21624	3962	186
1987	2324873	74690	3421256	5139044	9581789	19317	74	163	1876695	24713	21914	4326	188
1988	2390359	71828	3662125	5610536	10378044	19678	75	166	1971125	24449	22433	4470	192

Table 6 (Continued) part 2

YEAR	PINC	SALR	BKR	BXPVA	NPSR	CXPS	GRDR	PHDR	VHPS	VHPG	VAPG
69	.093	.520	.404	10.49	2.00	165.29	.18	.052	81	518	39.0
70	.084	.543	.379	10.98	2.02	164.14	.18	.057	80	528	36.4
71	.079	.551	.368	11.30	2.08	182.73	.17	.068	85	544	36.6
72	.070	.565	.356	11.53	1.99	181.79	.17	.064	88	569	34.9
73	.062	.568	.352	12.90	2.09	190.05	.18	.063	91	577	32.3
74	.053	.578	.354	15.27	2.04	198.38	.18	.063	94	593	28.2
75	.050	.577	.341	16.47	2.14	216.30	.17	.058	96	600	28.0
76	.049	.569	.341	18.49	2.18	236.18	.17	.056	95	591	26.3
77	.044	.574	.346	20.86	2.17	243.84	.17	.052	99	616	24.3
78	.041	.574	.336	22.84	2.24	265.40	.18	.053	103	616	22.8
79	.041	.568	.348	23.95	2.22	284.64	.19	.049	105	628	26.0
80	.038	.565	.347	27.35	2.20	305.16	.19	.048	107	607	22.7
81	.035	.562	.356	33.00	2.13	331.01	.19	.048	107	625	21.9
82	.036	.553	.348	34.34	2.16	353.40	.19	.046	109	612	21.4
83	.036	.550	.354	35.58	2.09	384.41	.19	.046	111	633	22.0
84	.034	.549	.355	38.07	2.10	403.02	.19	.044	114	636	21.8
85	.036	.537	.346	37.56	2.08	446.76	.19	.047	118	675	23.9
86	.032	.523	.353	44.34	2.07	481.34	.19	.048	122	687	21.5
87	.032	.522	.371	48.72	2.12	511.03	.21	.044	123	652	21.3
88	.030	.523	.366	55.19	2.12	541.26	.21	.043	124	647	19.9

Table 7

The Median-OLD (Mdn-O) ARL Library, 1969-1988 (n = 17)

YEAR	VH	VA	BX	SX	TX	LPSP	PSS	NPSS	MFLM	CURSER	TENR	GENR	PHD
1969	1011311	103670	1032891	1165300	2306931	7164	57	96	339481	N/A	16331	2760	135
1970	1058452	96540	829966	1307291	2162928	7524	59	110	376862	N/A	19439	2687	153
1971	1120466	97700	988935	1351498	2787983	7983	55	93	447369	N/A	18865	2829	182
1972	1244501	90911	949800	1309220	2470891	8400	59	89	560662	13272	19935	2834	203
1973	1327192	85345	979549	1507347	2723092	8500	60	95	627320	15818	19167	2781	208
1974	1435547	79686	1050439	1567819	2911370	8724	60	105	718419	16222	19265	2718	198
1975	1522682	77564	1218107	1691346	3124797	9430	62	105	787366	17325	19417	2794	193
1976	1476657	80178	1235855	1766472	3359074	10140	58	102	848696	16104	21033	2896	194
1977	1557201	75106	1300377	1903517	3480790	10500	61	102	915743	16087	21661	2939	184
1978	1613427	70991	1461633	2118456	4467578	10700	62	118	998488	16627	21686	3243	166
1979	1654927	71957	1694864	2384991	4990950	11134	61	120	1174434	17253	21611	3243	165
1980	1657850	71749	1620291	2592145	4975201	12000	61	112	1245012	17201	21759	3207	158
1981	1689508	72148	1698154	2966976	5490688	12900	62	115	1447129	17842	21999	3283	166
1982	1753213	69400	1847271	3254741	6183353	13680	65	114	1536205	17761	22708	3312	152
1983	1827150	65155	2133386	3489983	6539104	13800	64	107	1635707	18367	23354	3339	159
1984	1910374	66391	2355330	3552625	7355431	14560	67	107	1779160	19143	23036	3582	188
1985	1995437	72228	2582196	3905394	8113720	16291	68	115	1941649	20042	22776	3679	180
1986	2082128	66169	2808971	4358795	8752551	17000	72	112	1801291	20485	22553	3699	170
1987	2159570	66530	3203084	4743067	9352679	19000	70	127	1699685	21283	23446	3953	189
1988	2227255	78274	3480644	5151484	10416426	19500	68	121	1735808	20871	24160	4066	186

Table 7 (Continued) part 2

YEAR	PINC	SALR	BKR	BXPVA	NPSR	CXPS	GRDR	PHDR	VHPS	VHPG	VAPG
1969	.104	.508	.408	10.56	1.77	150.84	.18	.049	63	366	38.2
1970	.077	.548	.376	10.83	1.74	156.20	.17	.052	62	375	27.8
1971	.076	.538	.378	11.02	1.72	183.36	.17	.063	65	402	31.6
1972	.073	.565	.367	10.97	1.78	174.55	.17	.058	69	445	30.0
1973	.064	.565	.352	12.67	1.95	181.19	.17	.063	72	448	24.8
1974	.061	.569	.362	16.08	1.85	194.00	.17	.067	73	442	25.3
1975	.057	.570	.351	16.54	1.93	205.25	.17	.054	71	470	22.2
1976	.054	.574	.332	16.95	2.05	222.28	.17	.052	71	445	21.7
1977	.045	.576	.333	20.01	1.91	230.05	.16	.047	74	527	19.6
1978	.042	.563	.330	23.32	2.02	248.91	.17	.049	81	490	20.9
1979	.043	.558	.341	24.84	1.91	275.20	.17	.048	87	494	19.8
1980	.039	.563	.348	27.18	2.13	292.27	.17	.044	89	512	18.1
1981	.036	.548	.353	33.54	2.02	315.26	.16	.044	88	506	16.0
1982	.037	.540	.341	34.36	2.00	337.82	.17	.045	89	529	18.9
1983	.035	.550	.339	34.37	1.95	367.72	.17	.041	93	541	17.7
1984	.034	.546	.340	37.58	2.03	357.03	.16	.042	98	584	22.0
1985	.035	.529	.336	38.66	2.01	371.08	.17	.039	101	604	21.7
1986	.033	.523	.354	46.13	1.94	381.08	.16	.044	104	612	17.8
1987	.032	.522	.363	46.73	2.04	412.83	.18	.044	103	568	17.4
1988	.030	.507	.357	51.46	2.00	438.23	.19	.041	101	547	15.9

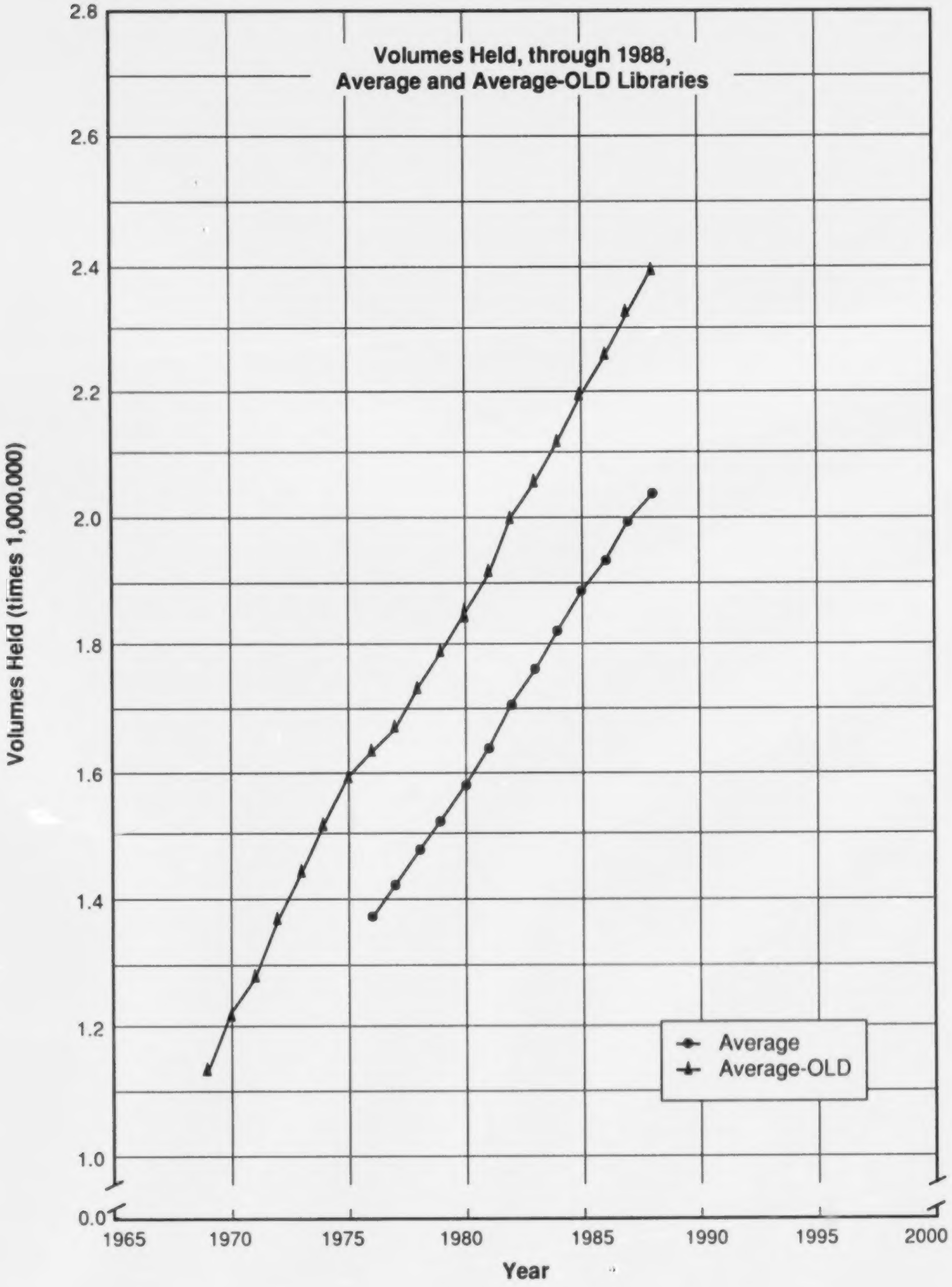

Figure 1. **Volumes Held (VH) in the Average (Av) and Average-OLD (Av-O) Composite Libraries**

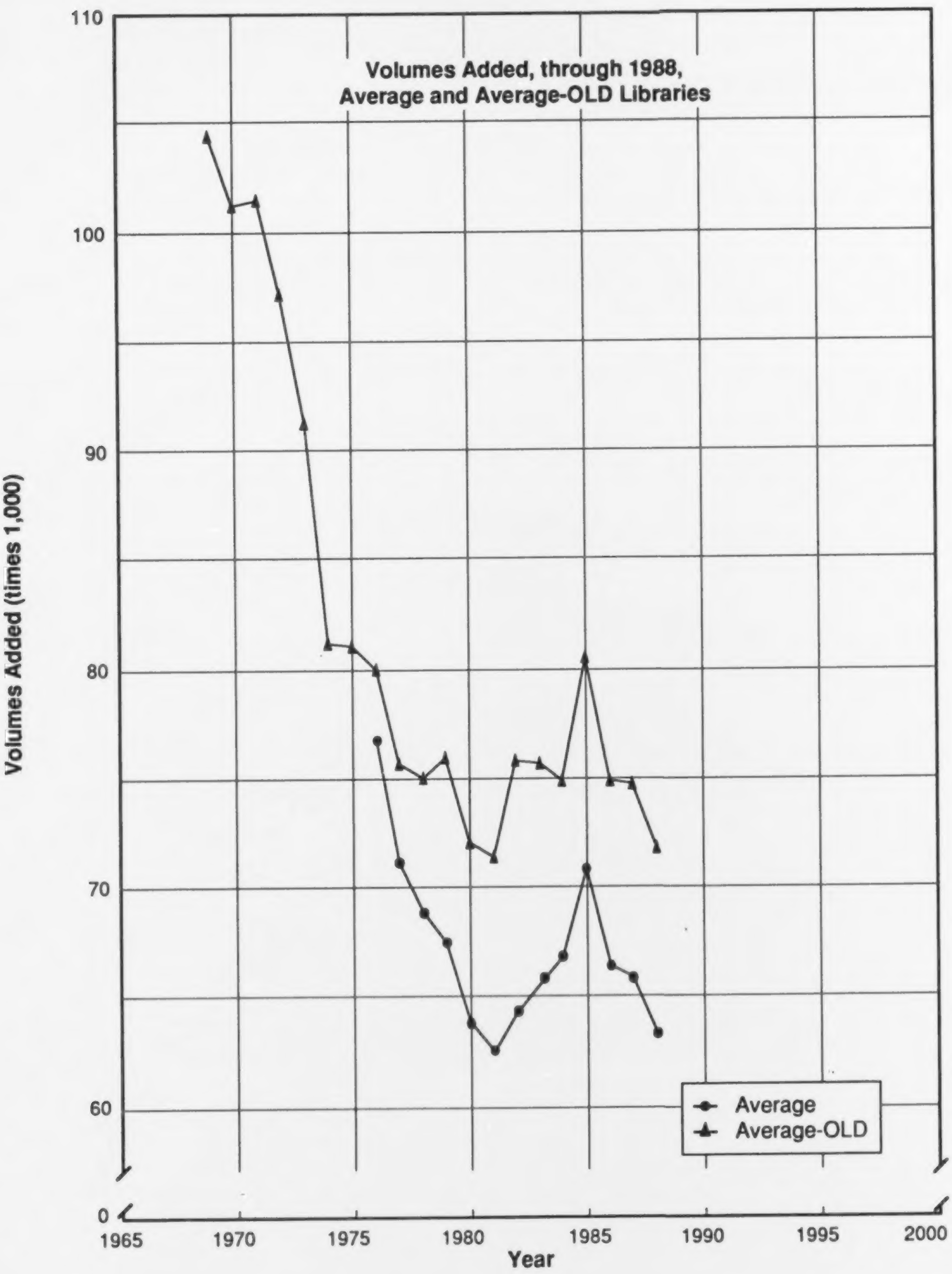

Figure 2. **Volumes Added (VA) in the Average (Av) and Average-OLD (Av-O) Composite Libraries**

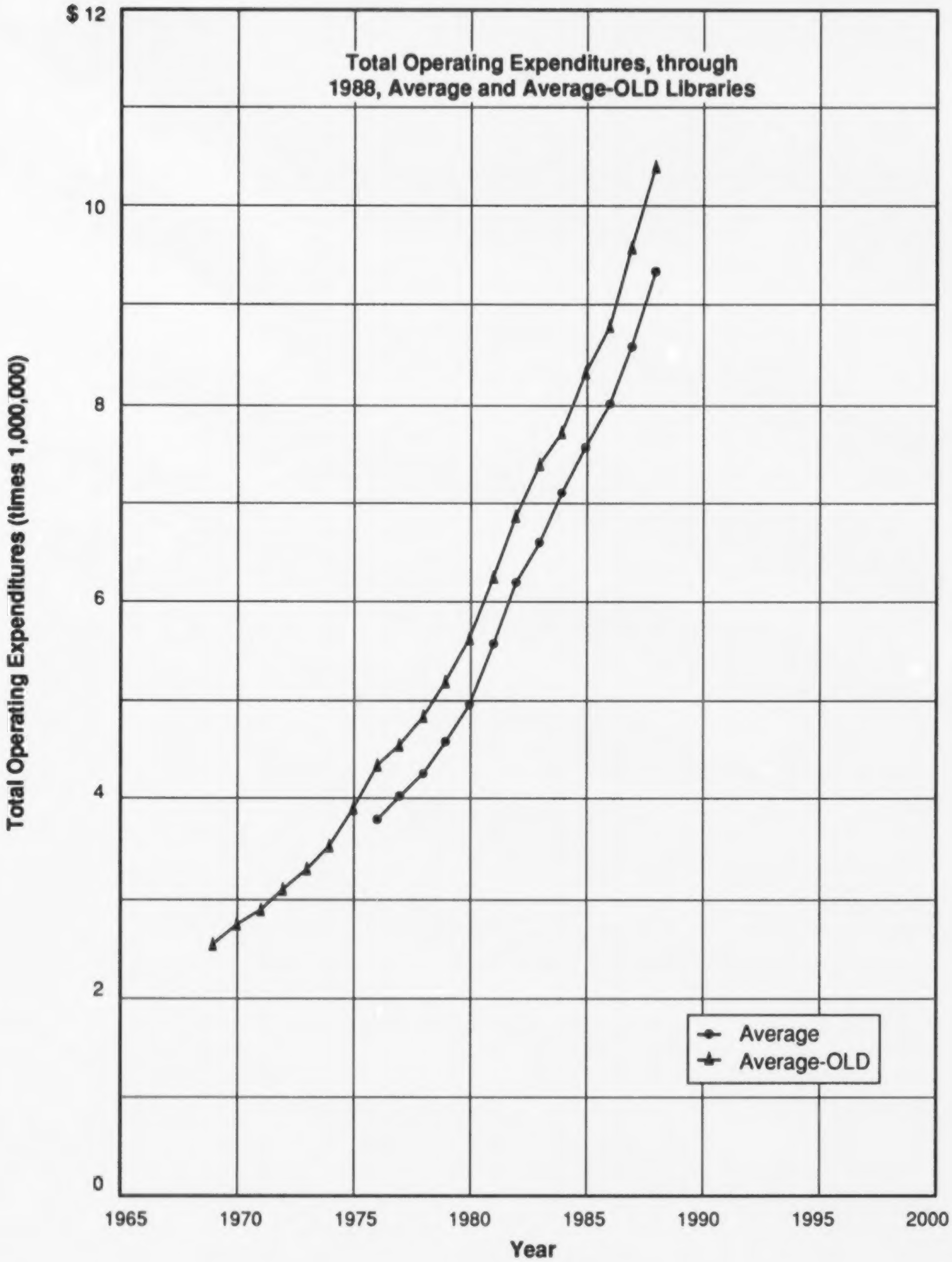

Figure 3. **Total Operating Expenditures (TX) in the Average (Av) and Average-OLD (Av-O) Composite Libraries**

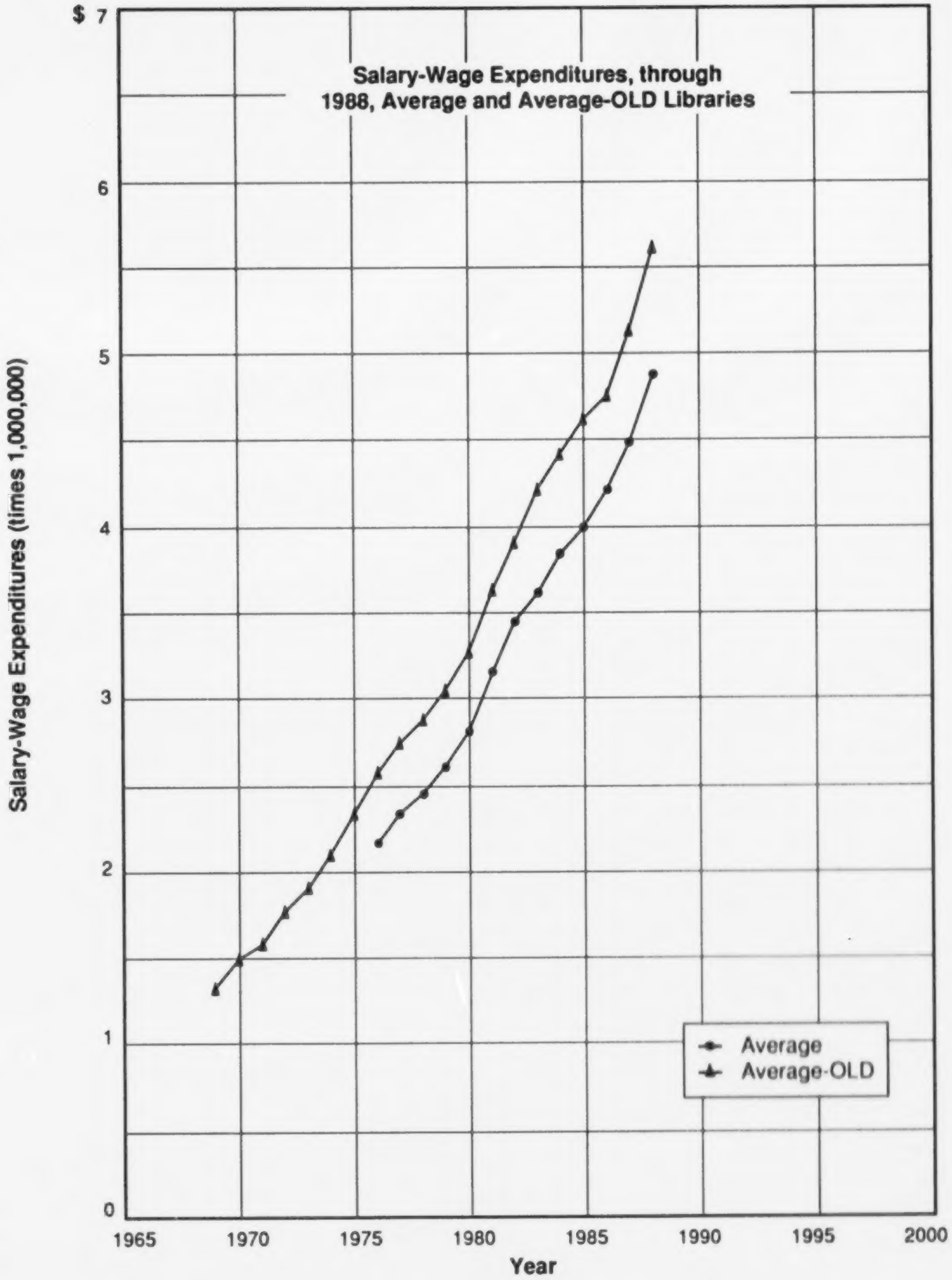

Figure 4. **Salary-Wage Expenditures (SX) in the Average (Av) and Average-OLD (Av-O) Composite Libraries**

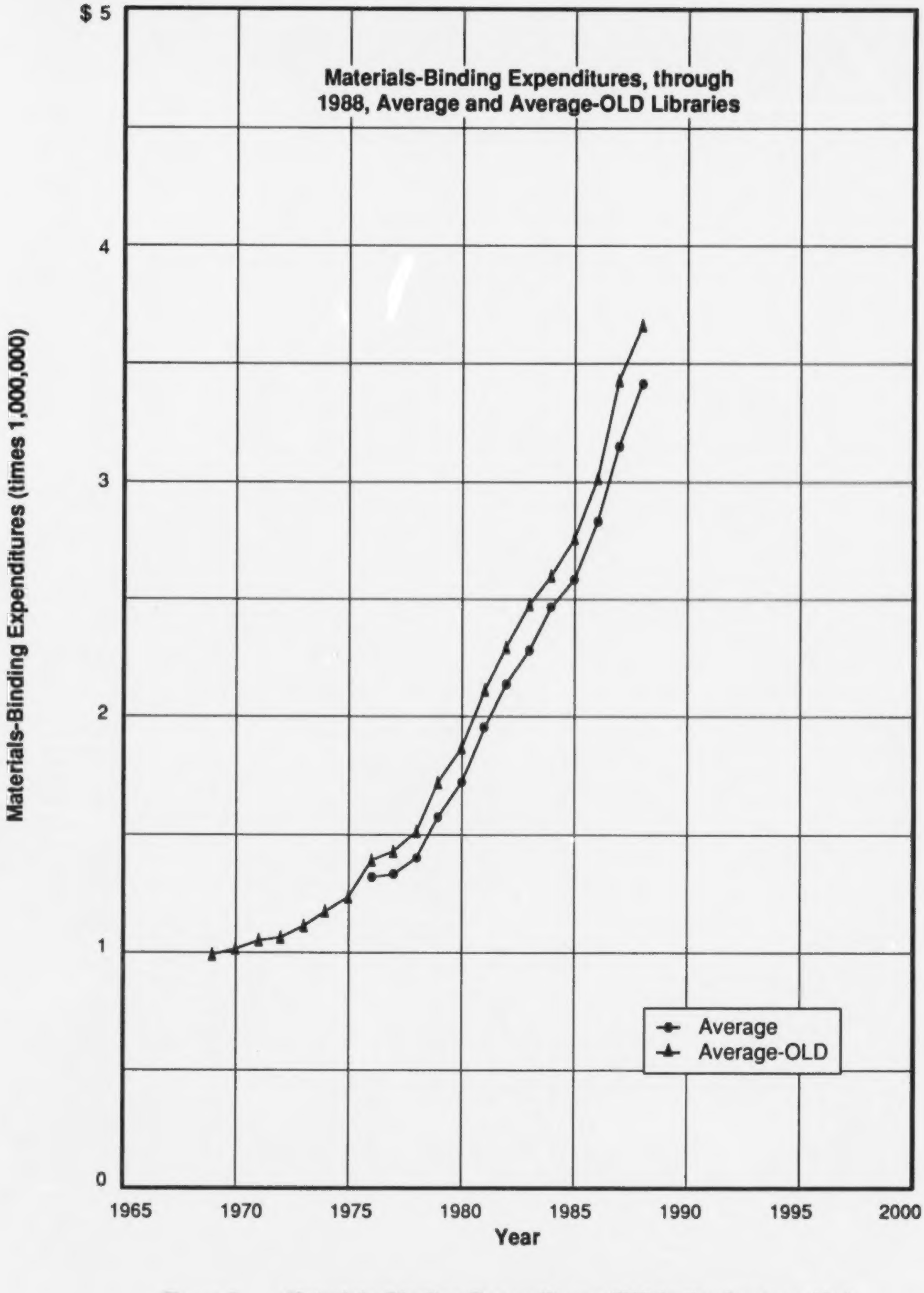

Figure 5. **Materials-Binding Expenditures (BX) in the Average (Av) and Average-OLD (Av-O) Composite Libraries**

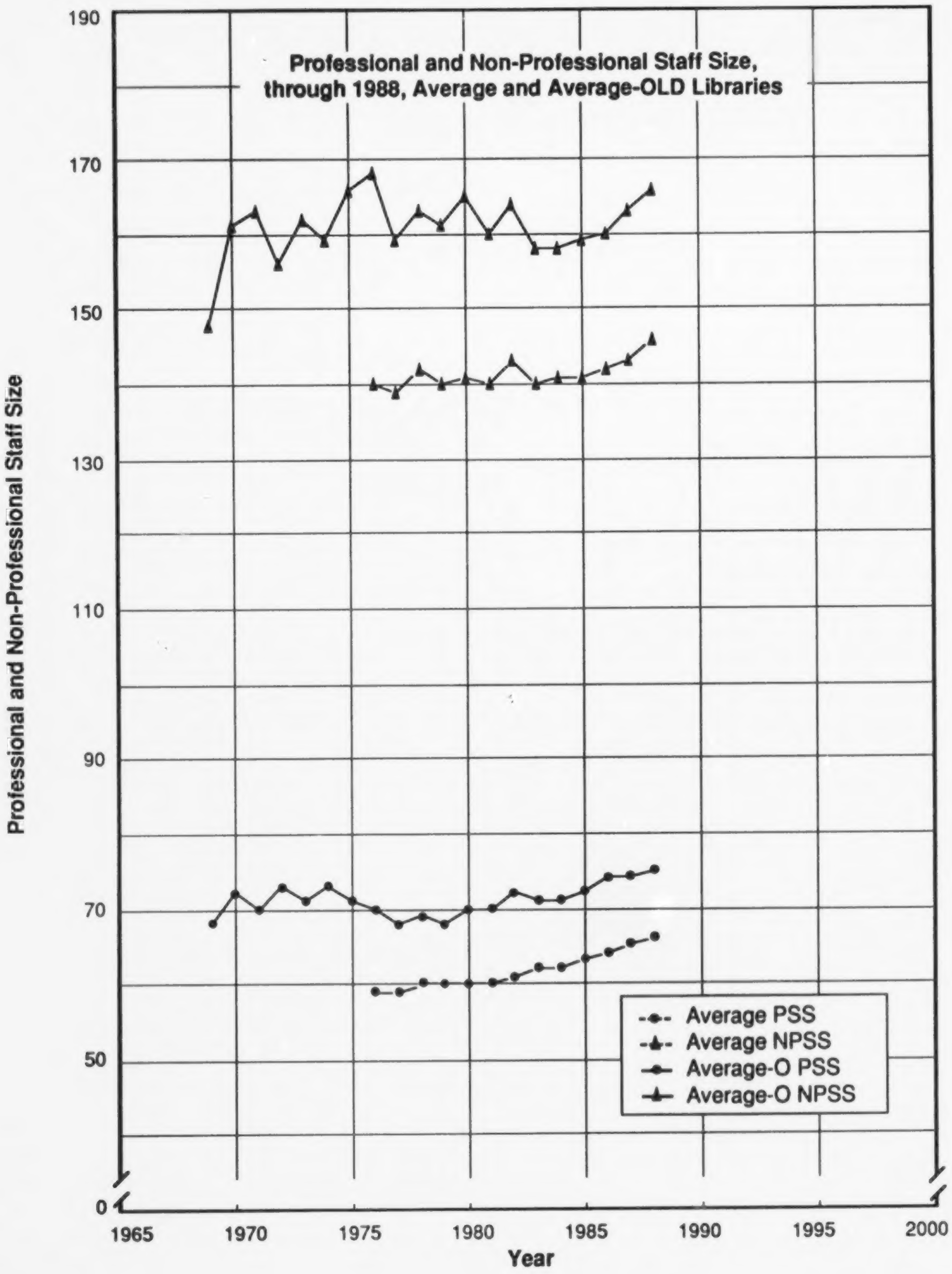

Figure 6. **Professional and Non-Professional Staff Size (PSS and NPSS) in the Average (Av) and Average-OLD (Av-O) Composite Libraries**

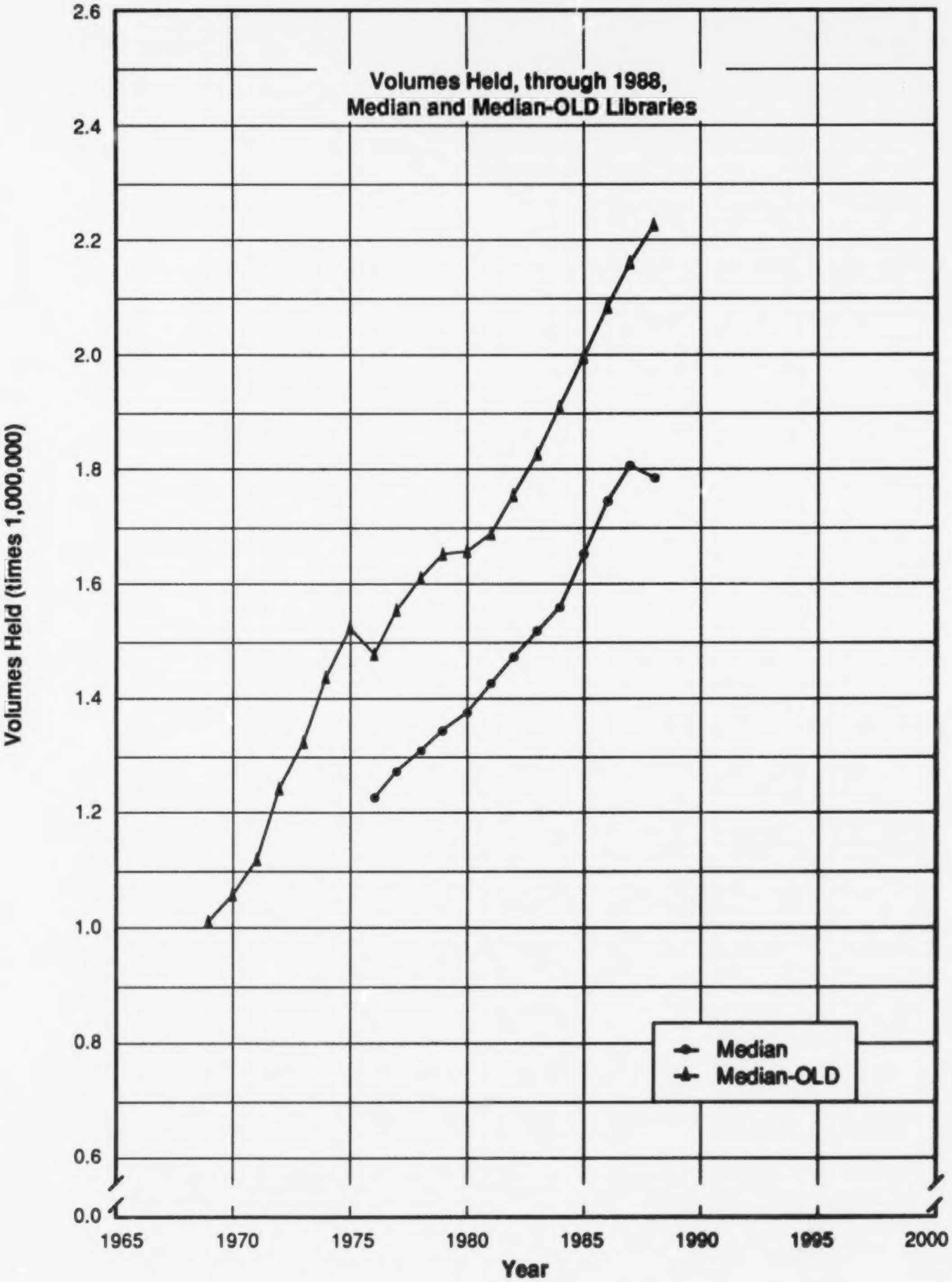

Figure 7. **Volumes Held (VH) in the Median (Mdn) and Median-OLD (Mdn-O) Composite Libraries**

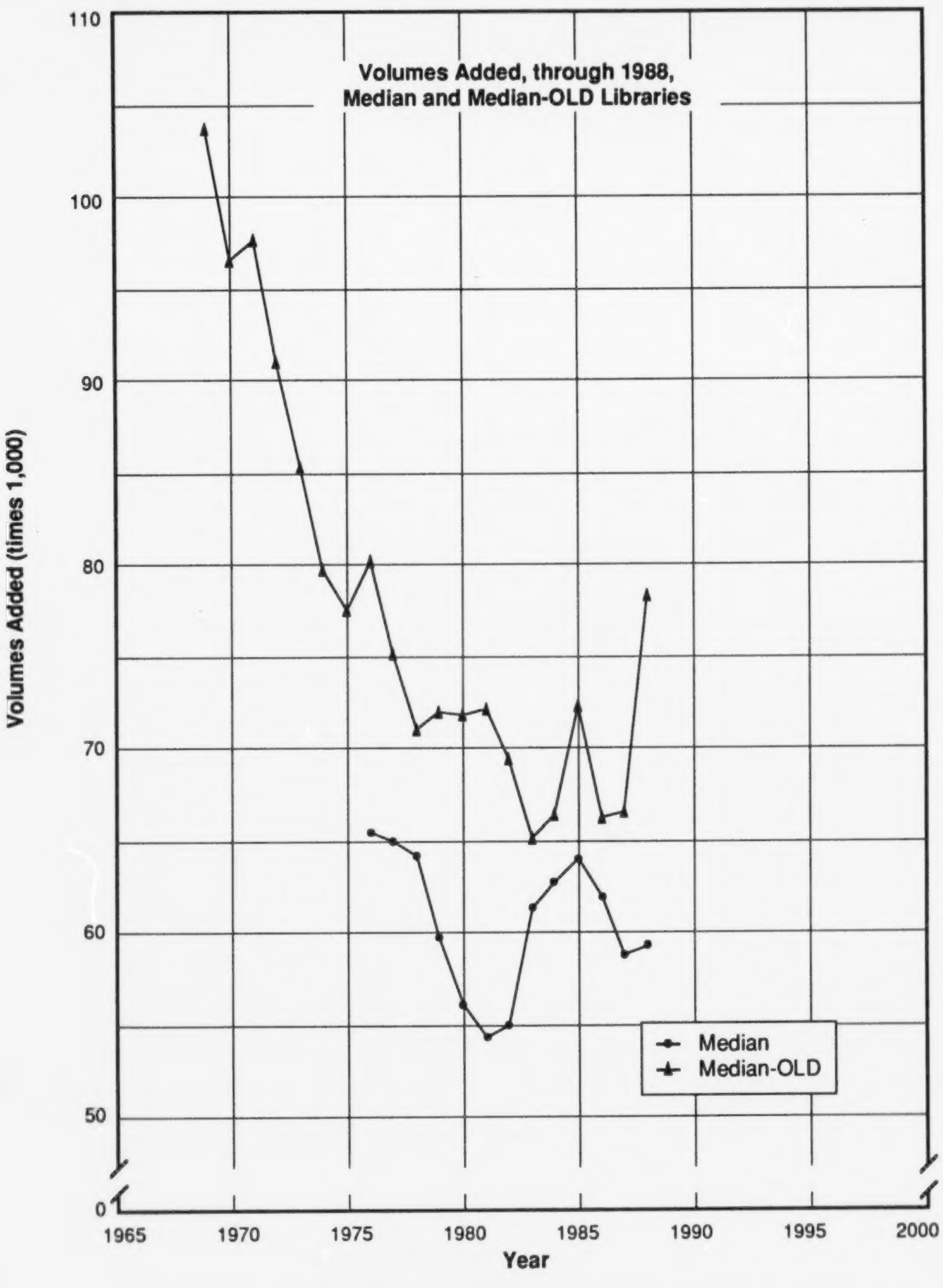

Figure 8. **Volumes Added (VA) in the Median (Mdn) and Median-OLD (Mdn-O) Composite Libraries**

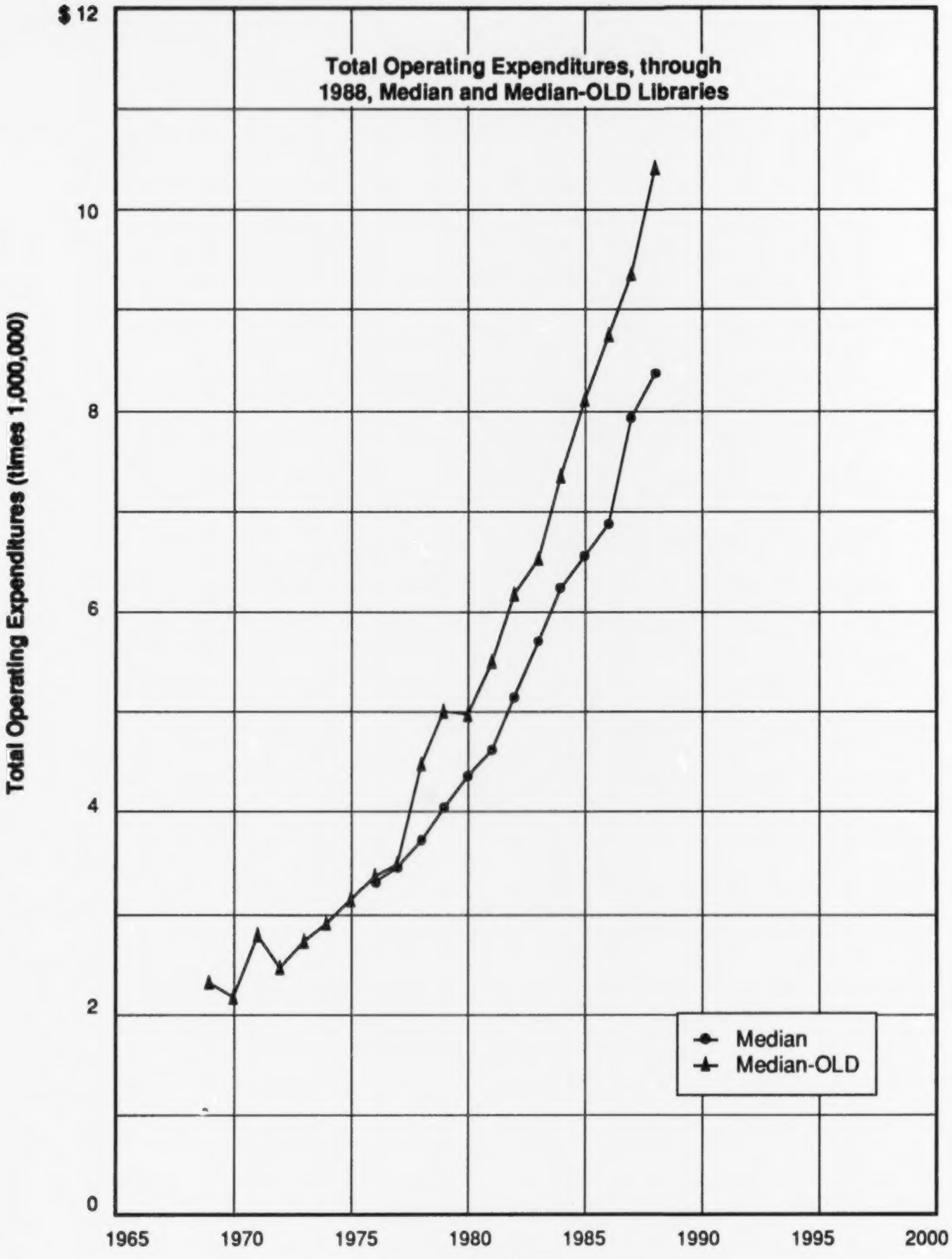

Figure 9. **Total Operating Expenditures (TX) in the Median (Mdn) and Median-OLD (Mdn-O) Composite Libraries**

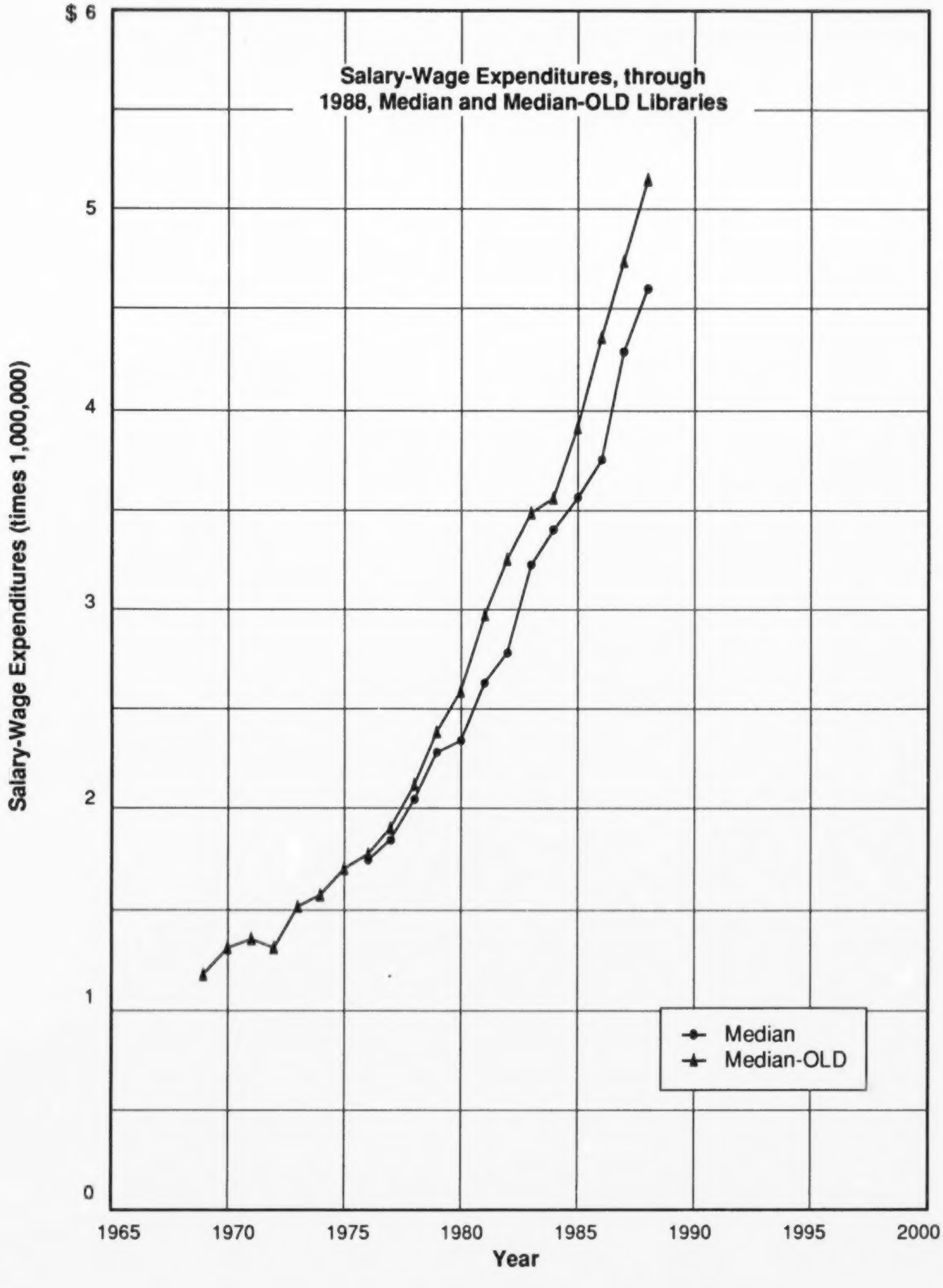

Figure 10. **Salary-Wage Expenditures (SX) in the Median (Mdn) and Median-OLD (Mdn-O) Composite Libraries**

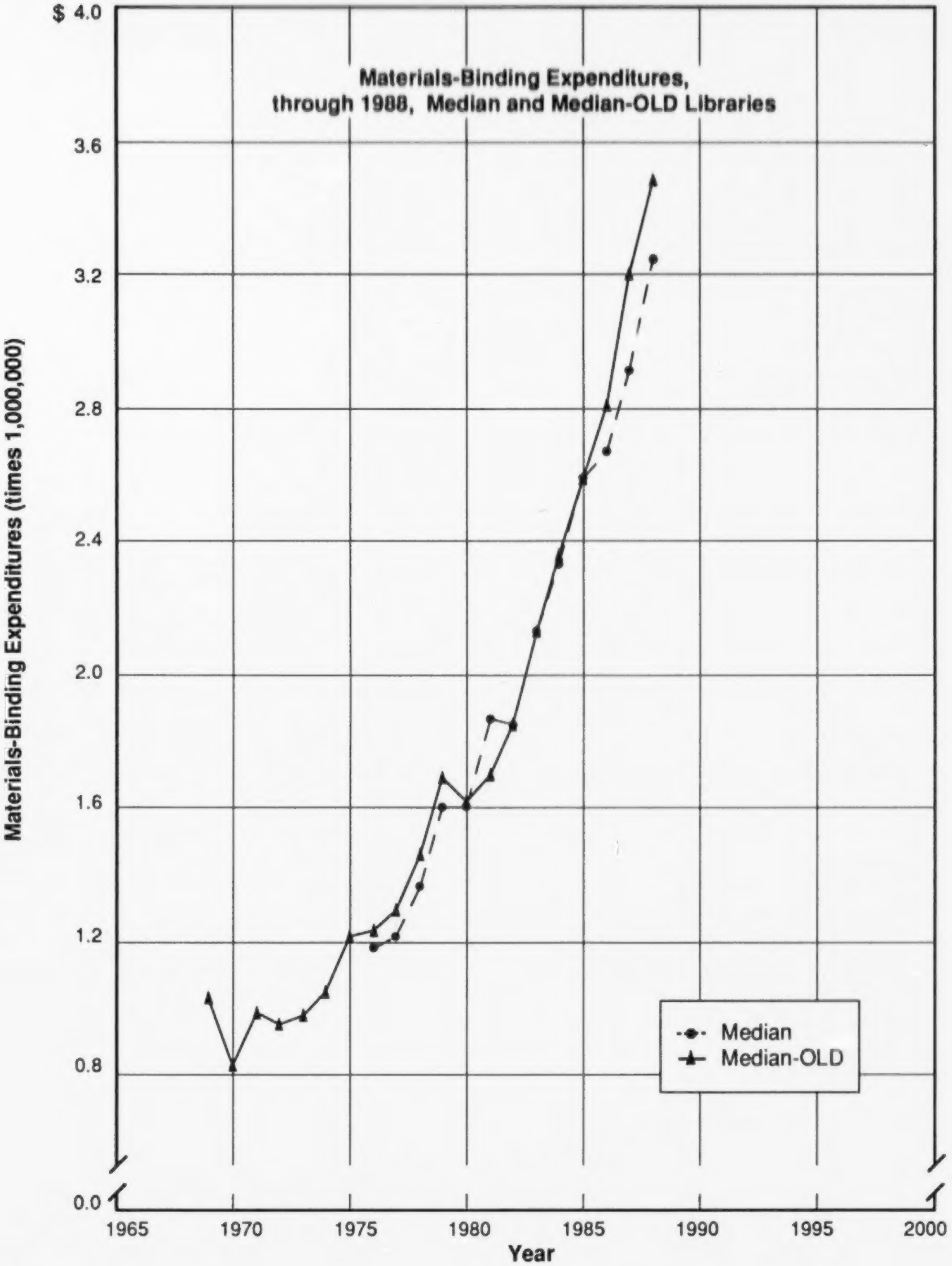

Figure 11. **Materials-Binding Expenditures (BX) in the Median (Mdn) and Median-OLD (Mdn-O) Composite Libraries**

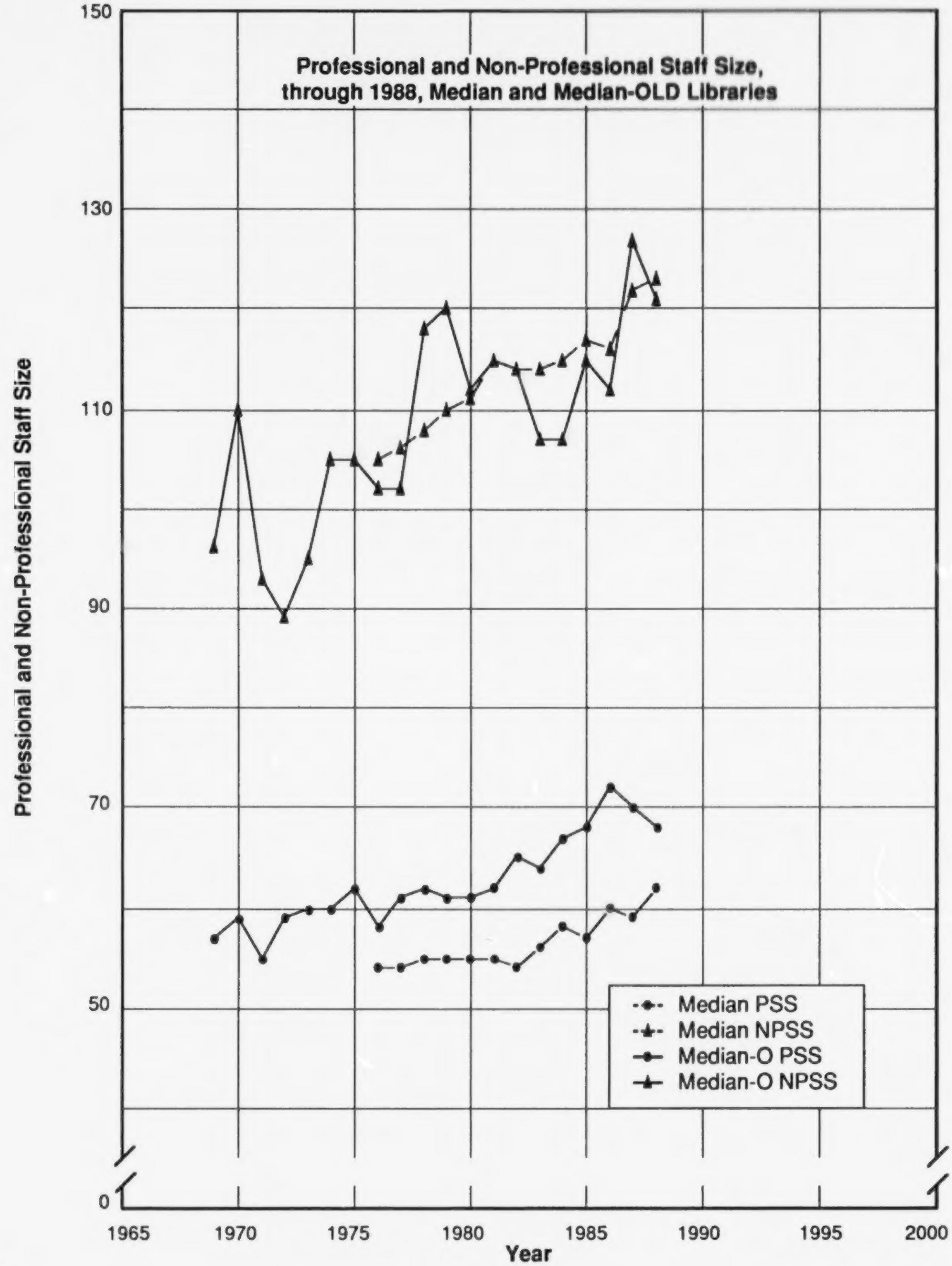

Figure 12. **Professional and Non-Professional Staff Size (PSS and NPSS) in the Median (Mdn) and Median-OLD (Mdn-O) Composite Libraries**

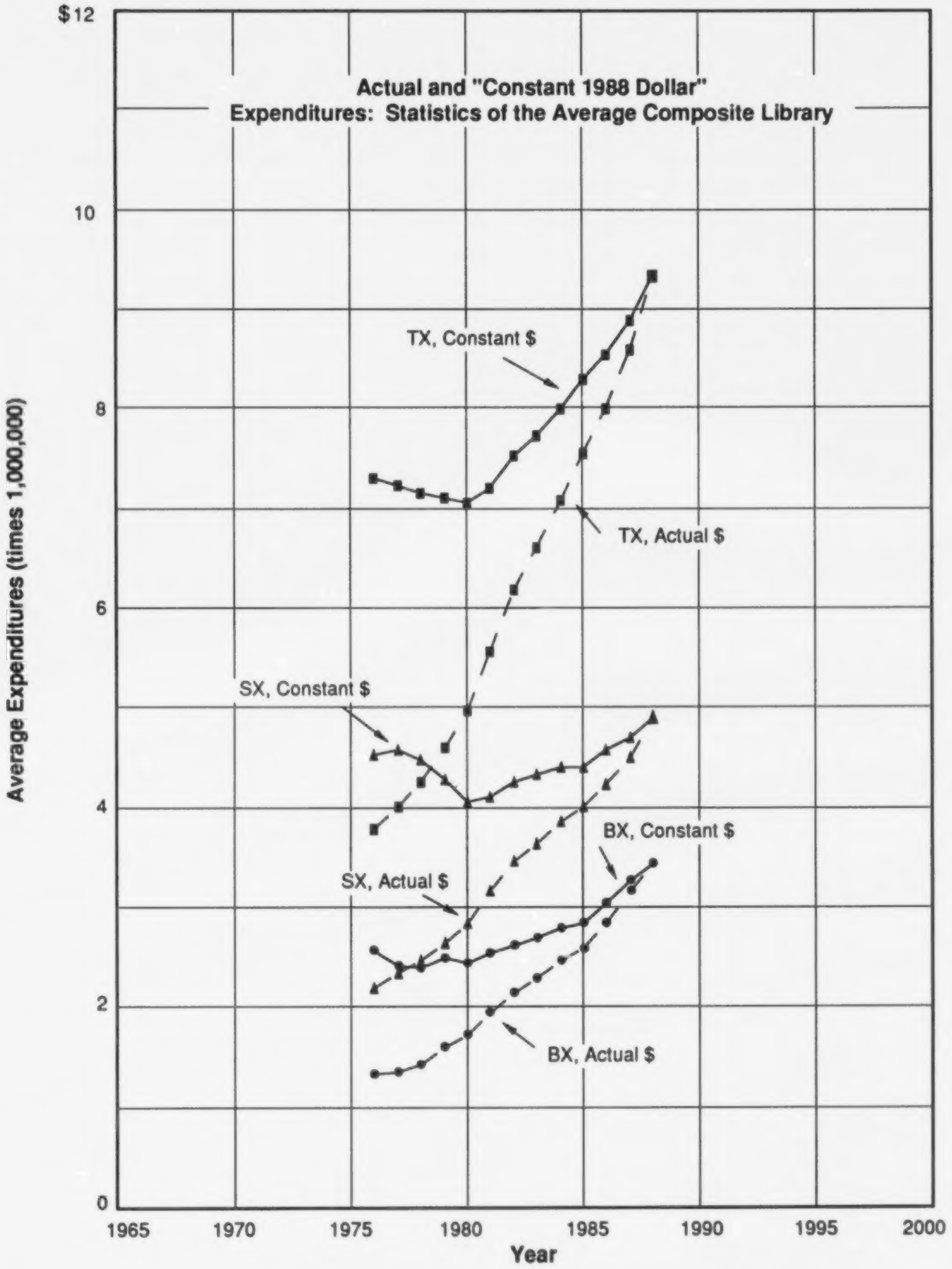

Figure 19. **Actual and "Constant 1988 Dollar" Expenditures for Material-Binding (BX), Salaries-Wages (SX), and Total (TX), 1976-1988 (SX Actual with CPI Data; BX and TX Adjusted with GNP Data)**

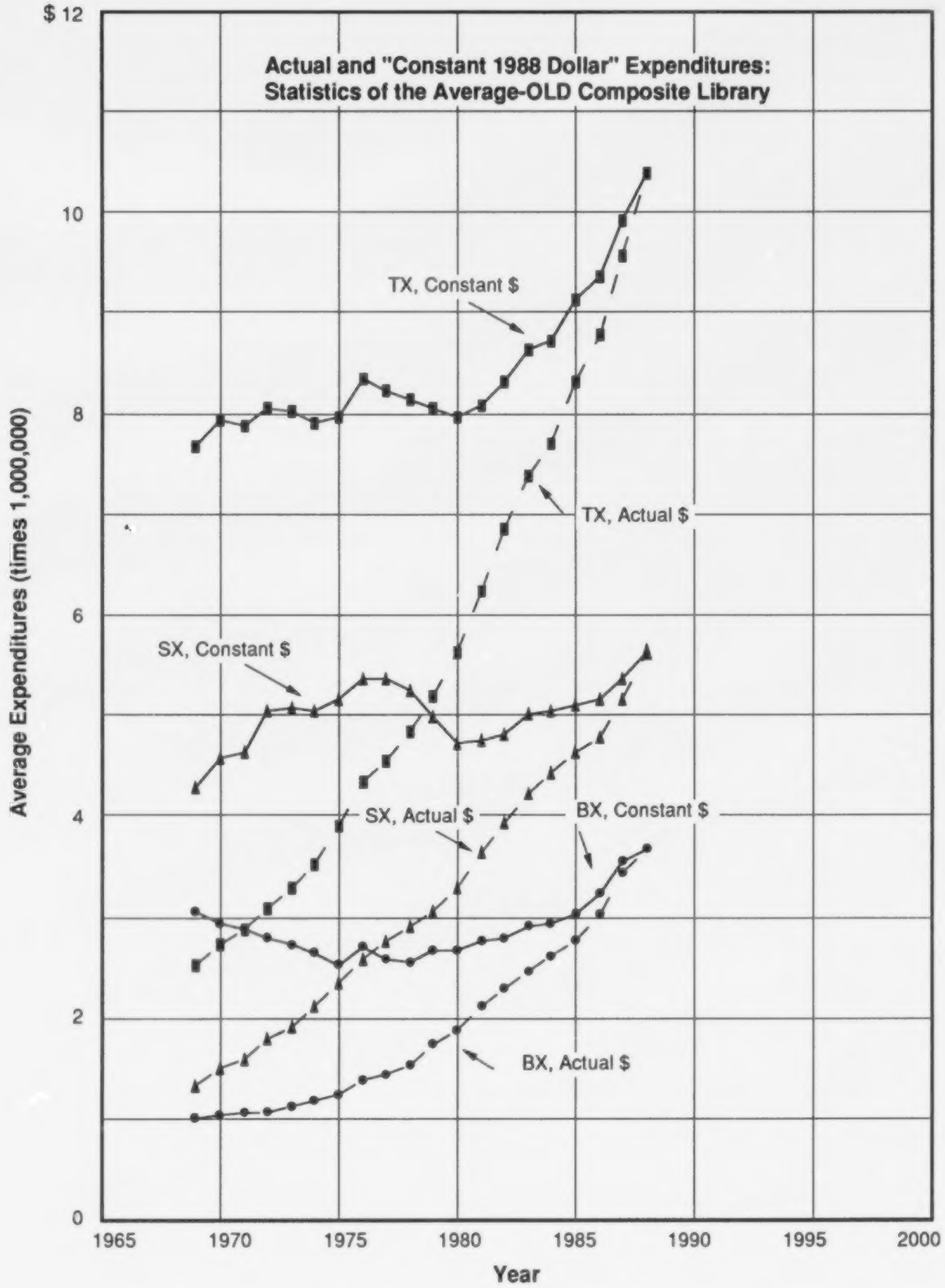

Figure 19a. **Actual and "Constant 1988 Dollar" Expenditures for Materials-Binding (BX), Salaries-Wages (SX), and Total (TX), 1969-1988 (SX Adjusted with CPI Data; BX and TX Adjusted with GNP Data)**

Table 11

Summary of Variable Intercorrelations*

	VAPG	VAPS	SALR	BKR	PINC	CURSR	MFLM	PHD	GENR	TENR	NPSS	PSS	LPSP	TX	SX	BX	VA
VH	055 004 -070	055 -046 -090	576 412 244	-178 -300 -392	171 082 -45	643 607 521	318 215 125	662 609 540	593 533 433	725 696 613	871 833 785	914 871 842	286 103 -183	856 805 725	875 813 779	744 664 551	905 877 638
VA	612 105 016	606 052 -021	507 316 -265	377 -181 -363	734 553 233	734 660 439	469 336 158	627 556 409	669 584 297	834 730 460	896 843 527	900 836 564	426 185 -041	917 832 663	880 818 522	880 797 717	
BX	445 166 -036	394 038 -108	291 048 -203	327 048 -171	667 536 263	823 733 552	624 483 275	581 442 283	479 411 267	692 539 407	779 720 635	796 725 604	502 350 058	908 867 798	807 730 666		
SX	218 108 -008	089 -017 -088	715 631 534	-441 -551 -641	402 263 -029	691 574 518	317 193 041	527 398 326	407 330 233	622 544 514	962 946 919	928 895 881	690 476 039	982 971 940			
TX	248 154 023	125 052 -085	540 432 340	-249 -454 -545	542 376 144	771 664 564	379 306 142	544 423 293	412 341 248	606 559 520	957 900 847	911 899 888	655 472 099				
LPSP	274 179 -117	206 038 -181	579 371 -82	-008 -439 -606	495 318 055	485 275 109	343 111 -039	256 052 -104	138 -014 -189	252 117 -226	543 311 -201	472 308 -127					
PSS	085 -033 -099	087 -049 -104	523 470 418	-342 -450 -546	369 257 -050	666 597 541	362 281 137	586 495 430	520 467 343	626 593 548	897 843 817						
NPSS	239 114 -008	095 -002 -073	626 582 453	-362 -441 -565	386 268 -030	612 524 469	269 193 -008	444 357 295	431 340 269	659 593 528							
TENR	-337 -423 -477	-363 -519 -572	439 325 050	054 -136 -253	504 269 072	510 460 391	424 401 236	718 671 585	874 853 811								
GENR	-396 -551 -610	-320 -426 -498	291 097 -053	155 034 -143	445 226 008	386 302 277	412 327 243	666 565 519									
PHD	-247 -397 -436	-233 -384 -425	280 164 045	068 -042 -187	276 061 -124	579 512 451	458 363 169										
MFLM	002 -085 -192	030 -074 -179	-027 -162 -250	317 225 056	482 307 117	576 490 280											
CURSR	155 126 -119	074 020 -144	231 135 -003	112 -057 -219	499 301 042												
PINC	756 218 012	765 192 004	169 -076 -542	647 130 -113													
BKR	444 002 -126	507 088 012	-514 -822 -947														
SALR	032 -117 -467	-120 -243 -503															
VAPS	964 845 758																

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*Decimal points are omitted. The three reported coefficients represent the highest, median, and lowest correlations between each variable pair. (Each variable pair was correlated 13 times, once for each year, 1976-1988.)

a result of inflation. In any event, Table 4 shows that BXPVA increased from $18.24 in 1976 to $59.35 in 1988, which is an increase of 225 percent. (During this same period, the GNP and CPI indexes increased by 92.9 and 107.8 percent, respectively.) The VHPS variable, defined as VH divided by TENR--volumes held per student enrolled--increased from 89 to 117 (Table 4), while VHPG, or volumes held per graduate student enrolled, increased from 541 to 606, and VAPG, or volumes added per graduate student enrolled declined from 30.6 to 18.8, a decline of about 38 percent.

Correlations among the Variables. The Pearson product-moment correlations reported in Table 11 are a summary of the results obtained by correlating 18 of the 24 study variables, from all 35 institutions, and for each year, 1976 through 1988. The 13 resulting correlation matrices are summarized in Table 11 by reporting only the highest, the median, and the lowest correlation between each pair of variables. These results are described and discussed below.

Discussion

Volumes Held (VH). Because of the sharp decline in the adding of volumes, the slowing of collection growth, the cessation of staff increases, and other lingering, post-1970 problems that were so recently described in RLT-I, we expected to find collection doubling intervals here that exceeded 20 years. But instead, the VH trends of Figs. 1, 7, and 13 provide both a surprise and a paradox. At first glance, they seem to show steady growth, about as expected, and a trend line that was essentially linear, i.e., a trend that lacked the upward and accelerating curve that Rider and Purdue had both found. This, then, seems to confirm that collections were not doubling as rapidly as the 16 or 17 year intervals that those early studies have reported. But on closer examination, the Median-OLD trend of Fig. 7 shows a doubling interval of 17+ years (see also Table 7), and the Average-OLD trend of Fig. 1 shows an interval of 18+ years (see also Table 6); in both cases, the seemingly linear and moderate trends displayed in the figures are deceptive. Furthermore, the short-run trends in Figs. 1 and 7, both beginning in 1976, parallel the long-run trends, and both will or would double in 19 years or less, if past growth rates could be maintained. Note also that collection growth in the 12 Large libraries is the most rapid of all, as the steep slope of its trend (Fig. 13, Appendix G) suggests; between 1976 and 1988, the 12 libraries' collections grew from an average of 1.813 million volumes to 2.793 million, i.e., they increased by a factor of 1.54, while the other composite libraries, all with smaller collections, increased by factors of only 1.40 to 1.51. Such growth in relatively large libraries is notable because of earlier evidence that associates larger collections with lower growth rates; clearly, though, that association lacks the strength and status of a prescription.

One thing that can help to clarify or justify the unexpectedly rapid growth of VH, as seen, e.g., in Fig. 1 or Tables 4 and 6 is the "PINC" variable, i.e., VA divided by VH. PINC is an approximate measure of a collection's annual percentage increase, and although, as already indicated, it somewhat overstates the actual percentage, it is a usable monitoring device. A review of PINC will show that, although it declines steadily over the years, it initially was unusually high, so collection growth in those years was unusually rapid. From 1969 through 1975, PINC ranged between 9.3 and 5.0 percent (Table 6), reflecting growth that translates into doubling intervals of eight or nine to 14 or 15 years. So, even though PINC, by 1988, had declined to the level of about 3 percent, rapid growth during the early years has counteracted much of this effect.

Volumes Added (VA). The trend lines that trace the adding of volumes are not pretty pictures. If read from Fig. 2 or from Tables 4 and 6, the most credible sources, they show a sharp decline in VA that begins "at dawn," in 1970, and that continues through 1981--registering an eventual loss of more than 30 percent--then VA recovers almost half of that loss (from 62521 to 70866, Table 4, see also Table 6) through 1985, and then it declines again (to 63249, Table 4) through 1988. Thus, the most recent trend is downward, and that, together with fresh memories of the troubled '70's, the brief duration of the recent (1982-85) recovery period, and the continuing pressures of materials price inflation make optimism difficult. VA decreases have now been recorded in 14 or 15 of the last 19 years, and conditions seem not to be brightening, so further decreases are likely, although it would be pure speculation to describe their duration or their size.

Total operating expenditures (TX). The TX expenditures have increased every year, as Fig. 3 or Tables 4 and 6 establish. The rate of increase is lower than that reported in RLT-I, where it averaged almost nine percent; here, it averages about one percentage point less, thus TX here is doubling in about nine years, not in eight. When this discrepancy was first noticed, we guessed that it originated in the fact that the present data, unlike those in RLT-I, are drawn substantially from the difficult decade of the '70's and that those difficult times produced smaller increases and lowered the average. It is not that simple, however, as a review of Fig. 3 will suggest. There are in Fig. 3 no major changes of slope since the end of the '70's, but instead the trends plotted there hardly deviate from a line that describes steady, rapid growth. As a further test of the role that the '70's played and using calculations based on data in Table 6, we found that TX's three "best" years were 1975, '76, and '81, with double-digit increases of 10.5, 11.4, and 11.0 percent, and that the three poorest were 1971, '77, and '86, with increases of 5.1, 5.2, and 5.4 percent. Thus, both decades have mixed records. Note also that over the full period of 20 years, the TX average increased from $2.507 million to $10.378 million (Table 6), or 314 percent, but when the effects of inflation are "controlled"--as well as they can be--the increases appear very differently (Figs. 19 and 19a). They show, e.g., in Fig. 19a that the constant $ TX remained just above or below $8 million through 1980, and that it then increased steadily through 1988, ending at about $10.4 million (see also Table 6). There are of course varied opinions concerning the value of applying inflation indexes--in this case, one that is nothing more than an inverted Gross National Product index--to library expenditures, but they have been applied here, with some reservations, because they might provide clues, and because they do provide some improvement over raw, non-indexed numbers.[25] One discovered clue is that constant $ salary-wage expenditures ended a three or four year period of sharp decline also in 1980 (Figs. 19 and 19a) and they have increased each year since. A second, but weaker clue is that library staff size, which could sustain no increase before 1980, began to register modest increases in 1982 or shortly thereafter and continued that trend through 1988 (Fig. 6).

Salary-Wage Expenditures (SX). The SX expenditures have increased along a path that parallels TX, at slightly more than half of the TX level, as expected. Between 1969 and 1988, the SX average increased from $1.32 million to $5.61 million (Table 6, see also Fig. 4), an increase of 325 percent, and essentially the same as the 314 percent that TX registered. To put these increases in perspective and to estimate changes in the economic well-being of library staff, consider the constant $ SX plots in Figs. 19 and 19a, plots derived by multiplying annual SX averages by a CPI-based factor (i.e., an inverted Consumer Price Index) from Column 3 of Appendix H. Bear in mind, too, that library staff size remained essentially unchanged until about 1982 and has increased only slightly since then. With these things as ingredients, the following story emerges: From 1969 until 1976 or '77, library staff salaries and wages increased ahead of inflation, and 1970, '72, and '76 were particularly good years. Then, staff pay did not keep pace in 1978, '79, or '80, and purchasing power declined, but then conditions improved and small gains appeared again in 1981. Since then, there has been some gain each year, and the best years were 1983, '87, and '88, when the trend moved sharply upward.

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[25] A small but interesting discovery is that, when Figs. 19 and 19a are placed together, aligned, and held to the light, they show six pairs of parallel plots, one set beginning in 1969 and the other in 1976, i.e., the TX, SX, and BX averages for the 17 "OLD" libraries have a growth record that closely matches the record of the total group of 35.

Materials-Binding Expenditures (BX). Two things are especially notable about the behavior and relationships of BX, and the first of these is that in the earlier years, until perhaps 1979, BX did not increase as rapidly as TX, as can be seen by comparing the pre-1979 slopes in Figs. 3 and 5. Note that during those early years, the trend line in Fig. 3 (TX) rises more sharply than the line in Fig. 5 (BX) and demonstrates that TX was increasing at the greater rate. This is confirmed also by the "BKR" averages in Table 6. The BKR variable, which is defined as the proportion of total spending that is spent for materials and binding, declines from .40 in 1969 to .34 in 1978, and notice also that BKR then increased gradually during the years that followed, reaching .38 both in 1987 and '88. Not that further confirmation is needed, but the relative shortages that BX endured can also be seen in the fact, mentioned earlier, that while TX increased 314 percent between 1969 and 1988, we know now that BX increased only 269 percent, from $.993 million to $3.66 million. Thus, the pieces of the BX trend "fit;" the initially gradual BX slope and the initial decline of BKR, as well as the comparatively small BX increase through 1988 provide differing perspectives on one process. A possible explanation for the recent BKR increases, those that have followed the earlier decline, is this: During the years before 1979, normal or customary BX increases were falling increasingly short of the rate of materials price inflation, and as a result, "volumes added" went into a sharp decline. In an effort to control the hemorrhaging of VA, BX (and indirectly, BKR) was increased repeatedly, increases that were made at least partly at the expense of salary and wage expenditures (and indirectly, of SALR). But even though total expenditures continued to increase steadily, and the BKR proportion increased noticeably, as SALR declined, the adding of volumes reentered a period of decline, indicating or confirming that no solutions had been found.

A second and perhaps the most interesting of many findings is that expenditures for materials (and for binding, which is a small, almost trivial, part of BX) is related to--i.e., correlated with--the number of volumes added, or VA, only within a given year, not across the years. In any single year, BX and VA correlate at the level of about .80 (Table 11, see also RLT-I, p. 108), a very substantial relationship. For comparison and for example, consider the longer trend lines in Figs. 2 (i.e., VA) and 5 (i.e., BX), and look first at trends between the initial year, 1969, and 1981, the year when VA reached its lowest point. Note that VA declined about 30 percent, while BX increased more than 100 percent; VA declined from its peak of 104,000 to 71,000, while BX increased from $.993 million to $2.11 million. Now, the next step will be futile, but let's try it anyway: Let's correct BX for inflation, as in Fig. 19a. With that done, the constant $ BX for 1969 becomes $3.04 million and for 1981, it becomes $2.74 million, which represents a decline of about ten percent and provides no aid to understanding. Rather obviously, the foregoing exercise is only one of many that could be tried; however, if the same procedures were repeated with other VA and BX data, for other series of years, the results would change little. Over time, BX will always increase, VA will do whatever it "wants" to do, and inflation adjustments will contribute nothing to understanding.[26] And although it is true that VA is not exactly a measure of how many volumes are purchased, and BX is not exactly a measure of money spent to acquire volumes, the variance in each measure is significantly determined by those purchases and expenditures, so that in any single year, VA and BX always correlate highly.

The absence of a VA-BX relationship across time presents a challenge that prompts two suggestions. The first is to refine both measures (in the manner that ARL has already undertaken[27]), and in the process, establish clearer logical connections between them. Statistical workers may consider this odd, something like gilding a lily, because in most settings, correlation coefficients of .80 are prizes, not calls to improve. Nevertheless, VA and BX, as presently defined, are relatively crude and complex measures that leave room for improvement. The second suggestion is to devise materials price indexes that are analogous to Labor and Commerce Departments' Consumer Price and Gross National Product indices. In doing this, since prices and increases for different classes of library materials vary widely (e.g., Moline, 1989), multiple indexes will be needed, but that is manageable, just as it is with CPI, GNP, and other such indices. The purpose would be to create a family of indices that are sensitive to price changes in each defined class of materials, and that are useful in planning and in monitoring the conditions in this unusually important domain. And a by-product of the undertaking would be the attainment of measures that resemble VA and a price-adjusted BX, but that are correlated across the years, as well as within a given year.

Professional (PSS) and Nonprofessional Staff Size (NPSS). The three trends that we have come to regard as the best indicators of research library health are volumes added, first, then total expenditures and library staff size. In the 1950's and '60's, these variables and all of the others increased regularly and rapidly. Then, in the 1970's, VA declined rapidly, as noted above and in

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[26] Other inflation indexes could be substituted in this process, but none seems likely to alter the outcome significantly.

[27] ARL now asks its members to report in detail their annual expenditures for monographs, serials, "other," miscellaneous, and contract binding, not just or not simply BX, as defined here, and it asks them also to report not only VA, as defined here, but net VA, number of monographs purchased, serials purchased, and serials not purchased. However, many members still report only the larger, undifferentiated statistics.

RLT-I (p. 111), the TX increases slowed briefly, but then resumed the same growth pattern as before (RLT-I, pp. 51, 116), and staff increases ceased. And now, an examination of the PSS and NPSS plots in Fig. 6 will show, first, that nonprofessionals outnumber professionals by more than two to one (in Table 4, most NPSR ratios are near 2.2 or 2.3 to 1). Such ratios were unknown 35 or 40 years ago (RLT-I, p. 29), and evidence indicates that they emerged because of the relative scarcity of professional personnel during the rapid growth years of the 1950's and '60's. Earlier, before growth rates and personnel requirements began to increase, professionals and non-professionals were employed in almost equal numbers, but by 1970 this had changed dramatically. In Fig. 6, notice also that both PSS and NPSS have increased slightly during each of the last several years. The increases are large enough to be noticed, but not large enough to be mistaken for the end of a drought. They are, however, one of the few positive signs to be found that might soften concern over the earlier and now the recent three-year decline of VA.

Current Serials (CURSER). Two things should be stated first: Of all the variables considered here, experience with CURSER is the most limited, and as a result, its behavior is difficult to evaluate. Also, as mentioned earlier, Stubbs and Buxton describe problems with the variable and advise that readers "take this category, before about 1974-75, with a grain or two of salt." (1981, p. ix) That said, the principal thing left to say is that CURSER's slight decline since 1985 may reflect nothing more than its somewhat unreliable nature, but on the other hand, it might also be a decline with the same origins as the recent and sharper decline of VA, which would be more serious. Forced to guess, we would have to guess that the origins are to blame, that library administrators are coping with this as one more problem that requires serious attention, and that CURSER's further decline is likely because problems still appear to be outdistancing solutions.

Total (TENR) and Graduate Enrollment (GENR). In recent years, TENR at the 35 institutions has increased in about the way that RLT-I's findings would lead one to expect, i.e., a modest ten percent, but GENR has increased far more than expected. Between 1976 and 1988, GENR increased by a fourth (Table 4), while GENR at RLT-I's 58 institutions, grew by half as much during the comparable period of 1973 through 1985. It is at least plausible that this difference reflects the difference in maturity of the two groups of universities. The 35 that are included here tend to be among the younger and more recently recognized research universities of North America, while the 58 institutions of RLT-I tend to be older and more established (and coincidentally, all of them U. S.-based). The graduate programs and reputations of the older institutions tend also to be well developed and stable, while those of the younger institutions tend to be incompletely defined, still developing, and growing.

Research Doctorates Awarded (PHD). The PHD trend reported in RLT-I ends in 1985, so its behavior since then is unknown and provides little basis for comparison. However, at the time, the PHD numbers were declining, as they had during all but one or two years since 1973, and overall, they had declined 24 percent from that peak year. The present data behave differently. For them, PHD declined, also beginning in 1973 (Table 6), but the decline extended only through 1980, then doctorate awards increased by 11 or 16 percent in the years since then (Table 4 and 6). The recent increases, like the GENR increases just discussed, are almost certainly related to institutional maturity and to institutional efforts to establish a niche in graduate education, and they are also consistent with some observations made after RLT-I was completed. At that time, the available evidence was essentially the following: In 1951, RLT-I's 58 institutions had awarded 87 percent of all U. S. Ph.D.'s (and other research doctorates), that this had declined to about 55 percent by 1985 (RLT-I, p. 27), and that 1973 was the peak year for doctorate awards, both among the 58 institutions (RLT-I, p. 29) and nationally (Center for Education Statistics, 1987, p. 192). We then noticed that, whereas RLT-I's 58 institutions showed a sharp PHD decline, equalling about 24 percent, the NCES statistics showed a modest decline of about five percent. By doing the remaining arithmetic, we found that the "other" U. S. doctorate-granting institutions (which include many more than the 28 included here) had increased their PHD awards by about 20 percent, and that this increase had largely neutralized the trend that RLT-I reported; the 58 institutions that formerly dominated U. S. graduate education, awarding almost 90 percent of the doctorates, were now awarding slightly more than half, while those that formerly awarded 13 percent, now awarded almost half. A highly visible shift.

Library Expenditures per Enrolled Student (CXPS). In the short run of years since 1976, total enrollment (TENR) has increased relatively little, so CXPS has been influenced most by increases in total expenditures (TX), and CXPS has inevitably followed along. Between 1976 and 1988, the per-student expenditures increased 130 percent, ending with an average of $540.89 (Table 4). And coincidentally, Table 6 reports that, over the same span of years, CXPS at the 17 institutions increased 129 percent and ended with an average of $541.26. Also, the longer run of years in Table 6 shows a 38 percent increase in TENR, so over that 20-year span, CXPS has been influenced by TENR, as well as by TX, yet during those years, it nevertheless increased by 227 percent. So, when enrollment is fairly stable, CXPS will increase at about the same rate as total expenditures, and the rule of thumb for that is eight or perhaps nine percent per year.

Correlations Among the Variables. The most pronounced relationships that were expected to appear among the correlations, and the relationships that do appear clearly in Table 11, are that VH or "volumes held" should and does correlate highly with each of six other primary library variables, namely VA, TX, SX, BX, PSS, and NPSS. In the past, VH has been seen to correlate with these variables and typically at the level of about .75 to .90 (Dunn, Seibert, & Scheuneman, 1965, p. 59; RLT-I, p. 108). However, since that earlier evidence came only from the studies just cited and thus from the single, fixed group of 58 libraries that those studies include, the relationships might in part be artifacts, i.e., they might be results generated partly by something unique in the composition of that group. But now that Table 11 reports median primary variable correlations that range between .664 (i.e., VH-BX) and .877 (i.e., VH-VA), there can be little doubt that VH and the other central variables are closely linked and that library "Bigness" (Reid, Seibert, & Kuenz, in press) is a dependable library trait. (We should note, too, that CURSER and VH yield a median correlation of.609, which suggests that CURSER also qualifies as a primary variable and as a contributor to the trait called "Bigness."

The correlations reported in RLT-I, as well as common sense, underlie the expectation that LPSP, or entering professional salary, is not a primary variable, i.e., that it is essentially unaffected by, and uncorrelated with, volumes held, or VH. In RLT-I, the median correlation between VH and LPSP is .096 (p. 108), and here it is .103 (Table 11), so the expectation is well supported. There is, though, some food for thought in the finding here that the median LPSP-SX and LPSP-TX correlations are .476 and .472, respectively. What these correlations seem to mean is that, even though common sense and earlier evidence both indicate that entering salaries are not a function of library size, but are determined largely by conditions in the current job market, it can still be true that libraries with large salary-wage and large total expenditures also tend to pay higher salaries to entering professionals, and to such an extent that more than 20 percent of the LPSP variance is present also in SX and in TX.

Among the many median correlations, two are especially notable because they differ so much from findings in the earlier studies. In the first of these, total enrollment, or TENR, is seen in Table 11 to correlate highly and unexpectedly with volumes held, or VH, besides which the median correlation ($r = .696$) is even slightly higher than that of either VH-GENR ($r = .533$) or VH-PHD ($r = .609$), which is even more unexpected. Instead, in the past, e.g., in RLT-I, median correlations of TENR, GENR, and PHD with VH were found to be .095, .355, and .643, respectively (p. 108), a low-to-high pattern that is much like the .178, .369, and .626 pattern reported in the first of the nine Purdue reports (1965, p. 59). Moreover, this same pattern is what most librarians would reason to be the case, because it describes, in order, the extent to which each of the three factors or variables should affect the demands placed on collections. So, although these results cannot be fully explained, they may be partially explained in the following way: With only 35 libraries in these analyses, the influence of a single unusual case can be considerable, and Toronto appears to be that case. Its large enrollment (currently, about 48000 students and the largest by far of the 35 institutions), together with its similarly large collection (about 5.7 million volumes, also the largest by far) have affected the TENR-VH correlations by "inflating" them to unusually high levels. By way of contrast, among the 58 institutions of RLT-I, Harvard has always had by far the largest VH--and Yale the second largest--but neither they nor any of the next several large VH institutions have total enrollments that compare, e.g., with Minnesota, Ohio State, Maryland, or Michigan State. Thus, unusually large collections and unusually large enrollments are, for the 58 institutions, usually found on different campuses. And vice versa. So we suspect that the large VH-TENR correlations of Table 11 reflect the considerable influence of Toronto's statistics, "assisted" by those of others that rank either high (e.g., Arizona) or low (e.g., Rice) on both variables.

The second notable and unexpected correlational finding is that the measure of collection growth rate, or PINC, and of collection size, or VH, appear here to be slightly but positively correlated, not negatively correlated, as earlier findings have indicated. The median VH-PINC correlation found here is .082 (Table 11), but in RLT-I, the corresponding value is -.379 (p. 108). In other words, collections of the larger libraries included here have tended to increase at slightly faster rates than those of the smaller ones, whereas much earlier evidence indicates a pronounced tendency in the opposite direction. This latter tendency can be seen not only in negative correlations, as mentioned, but in the fact that the larger composite libraries doubled their collections more slowly than smaller ones, both in RLT-I (e.g., pp. 79, 97) and the Purdue studies (e.g., 1965, pp. 37, 46; 1973, pp. 31, 40). It should be mentioned also that although the new results were unexpected, they could be suspected, if not inferred, from the earlier discussion of growth rates in the seven composite libraries. There, the 12 Large libraries' collection growth is described as the most rapid of any of the seven composite libraries, even though the others are all smaller. And finally, the plots in Fig. 14 also hint at this same finding; they show that although VA in the 12 Large libraries has declined since 1976, the decline is less dramatic than in the Mid-size or Small groups, and because of this, it is likely that the Large libraries' growth will be less adversely affected than that of the other two groups. In short, the bulk of the evidence shows that the 12 Large libraries are an unusually hardy and energetic group.

Concluding Thoughts About the Future. It is clear that the time has passed for investigators to "eyeball" the data, as Rider did, or to fit curves to the data, as the Purdue studies did, and then to announce some explicit and essentially optimistic predictions of future library growth. The cumulative record now is far more extensive, more complex, and less coherent than it once was, and it mixes positive and negative signals in ways that neither Rider nor Purdue encountered. Rider looked only at collection growth, and the record there was quite coherent, it always accelerated upward, over a span of more than a century. Purdue, on the other hand, looked at many more variables over the much shorter span of 22 years, but Purdue's "timing" also happened to be excellent, so again the records maintained their coherence, and all things accelerated upward. But conditions have not been the same since.

Collections still manage to grow at fairly impressive rates, at least for the time being, but it is impossible to tell what the combined, long-term effects of acidic volume losses, information technology, and resource sharing consortia will be. It is also apparent now that the adding of volumes, and perhaps the current serial receipt statistics, have the "ability" to decline almost as readily as they were once able to increase, so the long-term future of both will probably be affected most by finances and inflation, as well as by new technology and resource sharing (note that at least three of these factors can be expected to result in decreases). In any guesses about the future, the safest guess of all is that expenditures will continue to increase, and the best rule of thumb is that the annual rate will remain near eight percent, if not near or nearer to nine percent. However, the balance between personnel, library materials, and "other" expenditures has shown that it can shift. In the past, the rule of thumb was that 55 percent would be spent for personnel, a third for materials, and the remaining 10 to 15 percent for "other," but that balance appears to be shifting and the result may be a further decline in the personnel and a further increase in the materials fractions. The "other" fraction has received the least attention, as well as the least money, and in the future, to the extent that "other" represents expenditures for new technology, it is likely that its course will be even less predictable.

Future increases in staff size seem inevitable because, except for short-term fluctuations, staff numbers always increase and also because many library functions are inherently intellectual, personal, and labor-intensive.[28] Nevertheless, the balance between professionals and nonprofessionals on staff has shown that it can change dramatically. Almost 40 years ago, the two groups were in almost perfect balance, but the ratio now is 1 to 2 or 1 to 2.2, and there is no apparent trend that suggests a new or different ratio in the future. (A sidelight with some relevance to the future hiring of professional librarians is that their average entering salary in the year 2010 will probably exceed $55,000 and might exceed $60,000; in other words, that average is projected to be 3.5 or 3.6 times the 1985 average, which was $16,877 [RLT-I, p.29].)

The Last Word(s). The questions that launched this study are a residue left by RLT-I, and they are concerned primarily with the difficulties that appeared abruptly and very early in the 1970's and also with the signs of a developing recovery that appeared early in the 1980's. We hoped to discover more about events that occurred in the early '70's, to learn whether 1971 was--again or still--a watershed year, and to look again for causes. We also wanted to study data from the early 1980's, during the time when signs of recovery began to appear, to see what happened, to look for causes, and to see whether the recovery had continued. Central to all of the questions is the rate at which libraries add volumes, and thus the rate at which their collections grow.

First, in the search for causes, no answers were found, but we came instead to a conclusion something like Twain's, on the authorship of Shakespeare's works. Twain was a "brontosaurian" and as a (or the) brontosaurian, he believed that the evidence favoring Shakespeare was woefully inadequate, that the myth of authorship had been created in about the same way that a brontosaurus is created for a museum--with nine bones and 500 barrels of plaster of Paris. Similarly, we conclude that the concepts of inflation and austerity are inadequate to explain the library difficulties experienced during the 1970's, most notably the abrupt decline in growth and energy that struck libraries about 1971 and that continued at least through 1981. The evidence of inadequacy is in Figs. 3, 19, and 19a, as well as in RLT-I, especially Figs. 3, 4, and 29. Furthermore, the averages in Table 6 show that between 1970 and 1980, TX increased by a factor of 2.05--and in RLT-I, the corresponding factor is 2.07 (p. 29)--whereas the Consumer Price Index for the same period increased from 116.3 to 246.8, for a very similar factor of 2.12 (Appendix H). Moreover, one year earlier, the factor was only 1.87, so a disproportionate share of the increase is attributable to the last year, 1980, not to an early year, when the difficulties were clearly present. In short, we conclude that there are "nine bones" in the evidence, but that a completed inflation-austerity brontosaurus also requires large quantities of plaster of Paris.

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[28] A corollary to the belief in continuing collection growth is that physical facilities will expand, and a corollary to that would seem to be that staff size must also increase to maintain a necessary, irreducible "population density."

On the question of whether 1971 was a watershed year that marked the beginning of serious difficulties, the answer is essentially yes, because that is what the bulk of RLT-I's evidence (pp. 49-55) indicates, although Fig. 2, above, also indicates that there must have been libraries for which the adding of volumes began to decline at least one year earlier. A clearer answer to this could probably be gotten by determining, for many individual research libraries, the year in which there was a "significant" discontinuity in the growth trends of volumes added, total expenditures, and staff size. Currently, the signs are that some libraries experienced discontinuities at least two years before or after 1971, but that year still represents the best single estimate. On the related question of what happened in 1971, three things stand out: the adding of volumes "went flat," then eventually declined sharply, rather than continuing to increase, as this statistic had during 20 earlier years (RLT-I, p. 49; Fig. 2, above); increases in total expenditures continued during the first two difficult years, but at reduced rates (RLT-I, p. 51); and staff size no longer increased, but stabilized at its 1971 level (RLT-I, pp. 29, 55).

If recovery is defined in terms of the rate at which volumes are added, then a recovery began either in 1983 (RLT-I, p. 49) or in 1982 (Fig. 2), and the observed increases in staff size either agree with these dates (RLT-I, p. 55) or they might be interpreted as indicating 1984 (Table 4; see also Fig. 6). Finally, on the question of whether the recovery continued past 1985, Fig. 2 clearly indicates that it did not (see also Tables 4 and 6); in 1986, '87, and '88, the average rate at which volumes were added declined, and over those three years, the decline was from 70,866 to 63,249 volumes.

So far, so good, but unfortunately, the large questions all remain unanswered: What IS IT that determines whether research libraries do or don't grow predictably and energetically? Once they did, then they didn't, then briefly they tried to, but most recently they haven't. What forces propelled them through the '50's and '60's, and what was it that came upon them suddenly, about 1971, and severely restricted growth for the next dozen years? Why, too, after that, was there a period of recovery, one that lasted only through 1985? It appeared, then it disappeared. And is this significant for 1990, '91, and beyond? Then, besides, if inflation and austerity are inadequate as descriptive or explanatory concepts, are others better? The roller coaster, perhaps? It labors uphill, descends, up again, descends again, and it can repeat the cycles endlessly. Or what about threshold effects? Beyond some level, some point, some threshold, the significance and difficulty of movement and control change. Or maybe a game of dice, a crap shoot? There, some outcomes are demonstrably more likely than others, but single future outcomes cannot be predicted. Or sky diving? Exciting and not cheap, it places a premium on courage and reliable technology, and each ascent is followed promptly by an exposed and vulnerable descent.

Who knows? But whatever the forces that determine research library trends, they aren't simple. And wouldn't it be nice if they were a little less elusive?

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Appendix A

A Listing of the Nine "Purdue Study" Reports, 1965-1973

The first of the Purdue reports appeared in 1965 and set the pattern for eight annual updates that came later, the last in 1973. All are based on annual statistics of 58 academic research libraries and their parent universities, and the reports present three kinds of analyses and results. The centerpiece of each report is a series of trend analyses, based on eight "composite" libraries of differing size; these trends trace the statistics of growth from 1951 through 1964 and, in selected cases, project the trends forward to forecast growth through 1980. A second set of analyses determines year-by-year rankings of the 58 libraries, based on their holdings, volumes added, and operating expenditures, and the third set are year-by-year correlations of the variables.

The first report analyzes data that span the years 1951 through 1964, then each later report adds data summaries that represent the most recent year. Also, the sixth report, published in 1971, and the two that followed, include a set of 28 new forecasts, based on data that extend from 1951 through 1970.

The nine reports are:

Dunn, O. C., Seibert, W. F., & Scheuneman, J. A. (1965). The past and likely future of 58 research libraries, 1951-1980: A statistical study of growth and change. Lafayette, IN: Purdue University, University Libraries and Audiovisual Center.

Dunn, O. C., Seibert, W. F., & Scheuneman, J. A. (1966). The past and likely future of 58 research libraries, 1951-1980: A statistical study of growth and change (2nd issue). Lafayette, IN: Purdue University, University Libraries and Audiovisual Center.

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Dunn, O. C., Seibert, W. F., & Scheuneman, J. A. (1968). The past and likely future of 58 research libraries, 1951-1980: A statistical study of growth and change (4th issue). Lafayette, IN: Purdue University, University Libraries and Audiovisual Center.

Dunn, O. C., Seibert, W. F., & Scheuneman, J. A. (1969). The past and likely future of 58 research libraries, 1951-1980: A statistical study of growth and change (5th issue). Lafayette, IN: Purdue University, University Libraries and Audiovisual Center.

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Appendix B

Introduction[1]

If any one thing could be said to characterize the literature on library growth, it is a persistent and sometimes anguished ambivalence, and except for obvious problems, if any one person could be the patron saint of authors in the field, it is "Fiddler's" Tevye of Anatevka. On the one hand, library growth is described as rapid, accelerating, daunting, and destined to remain that way. But on the other hand, authors often recognize the uncertainties that underlie the prediction, so they hedge by noting that indefinite continuation of such growth is impossible, and besides, the statistics used to measure growth are not well defined and hence, their results cannot be trusted (e.g., Piternick, 1977). So, in much of the literature, authors appear to be agreeing and disagreeing with themselves and each other, more or less at the same time.

Rider came first and, in a brief article (1940), he presents statistics that later also formed the basis for his book (1944). In four tables and one figure, both publications record and summarize collection growth in the same four groups of American colleges and universities: universities dating from 1831, universities dating from 1876, colleges dating from 1831, and women's colleges. Much of the article's text calls attention to the observed doubling periods of the libraries' collections, with such comments as "these ten great early university libraries doubled themselves not every twenty but every sixteen years" (p. 8), and "our college and university libraries have, on the average, taking them as a whole, doubled in size in about every fifteen years" (p. 9), or "[it is] almost axiomatic: unless a college or university is willing to be stagnant, . . . it seems to be inevitable that it must double its library in size every fifteen or twenty years" (p. 11). But after arguing the case for rapid and continuing growth, Rider's last page includes:

> Whether college libraries must continue to grow at the rate that they have, and in the way that they have, rests primarily upon exceedingly complex questions of educational method and policy. (1940, p. 11)

Unstated but unescapable is the conclusion that, since the "exceedingly complex questions" were as yet undecided, then future growth rates were also. Four years later, Rider (1944) begins his book with:

> It was not realized until a few years ago that [research libraries] were, on the average, actually doubling in size every sixteen years. And . . . this [parabolic growth] was not in any sense a recent phenomenon: all our research libraries had grown at this rate, without substantial deviation either upward or downward, ever since they began in this country, over three centuries ago. (p. 3)

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[1] This Introduction is taken verbatim from the 1987 RLT-I report.

He repeats the "sixteen year"[2] phrase eighteen times through page 16 and emphasizes his point with: "universities of this age-group [i.e., founded since 1849] have doubled in size, not every sixteen years, but every nine and one-half years!" (p. 6); and "it seems . . . that, ever since college and university libraries started in this country, they have, on the average, doubled in size every sixteen years" (p. 8); and "so far as we have figures available, neither library [Harvard and Yale], in even a single generation in its long history, has deviated substantially from our established 'doubling' rate of research library growth" (p. 11); and

> Growth has continued, without any significant change of rate . . . for over thirty decades, and at a rate so uniform over so many years, and so uniform in so many different libraries that it might almost seem as though some natural law were at work. (pp. 15-16)

But Rider (1944) also expresses reservations concerning future growth prospects, beginning with the second paragraph of Chapter I:

> Now, when anything is growing parabolically, there obviously is going to come a time when some sort of impasse begins to impend very rapidly indeed. And it is evident, when one considers the statistics, that American research libraries are fast approaching this particular point in the curve of their history. (p. 3)

He then presents twelve pages of statistics and comment that support belief in rapid growth but follows with: "nevertheless, if research librarians were asked categorically whether they thought doubling every sixteen years was going to continue indefinitely, most of them, like the writer, would probably answer 'no'" (p. 16). Thus, Rider, like others who followed, goes to the brink of concluding that trends from the past describe trends for the future but then draws back, although not so completely that he can avoid concluding Chapter I with: "librarians and educators cannot look to the outside world for any solution to their problem of research library growth. If they do, they are surely going to be overwhelmed. They must find a solution themselves" (p. 19).

There is ambivalence in Metcalf's writings also, but for reasons that are generally opposite to those of other authors, who seem to lean toward belief in a continuation of past growth but who stop short of unvarnished commitment. Metcalf leans away. In a letter to Rider, he wrote: "it is perfectly true that for the past two or three generations, we have been unwilling to face the growth of the future . . . . But I am convinced that a turn in the road has come. Curves of that kind have to change some time" (see Rider, 1944, p. 16). Similarly, in his review of Rider's book, he writes:

> Mr. Rider . . . has converted many librarians to the thesis that since libraries have been doubling every sixteen years for the past three centuries, there is reason to believe they will continue to do so. The reviewer takes the stand, however, that the turn of the road was reached even before the great depression of the 1930's; that the second World War has made the turn

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[2] Between 1940 and 1944, Rider seems to have concluded that the best estimate of an average doubling period was sixteen years, although he earlier mentioned various figures, mostly in the fifteen to twenty year range.

> an abnormally sharp one and that the future growth of our large libraries, taken as a group, will be more by arithmetical progression than by geometrical[3]. (Metcalf, 1945, p. 170)

But, ten years later, in "Facing the Consequences of Growth" (Metcalf, 1955), parts of the article read like words from a convert. After citing some of Harvard's statistics:

> . . . We occupy twelve million cubic feet of space, costing more than $470,000 annually. . . . Our needs for space increase every year . . . . We have nearly six million volumes and pamphlets . . . . Fifteen thousand persons cross our thresholds daily . . . and it sometimes seems that every book [ever printed] is wanted or will be wanted by some reader (p. 118);

he then adds:

> Let me warn you: where Harvard is today in size and costs, Yale will be tomorrow, figuratively speaking; California, Chicago, Columbia, Illinois, Michigan, and Minnesota will be there the next day[4]; and many others will arrive the day after that. It may be later than many of us think. (p. 118)

In a brief article, "Rider Revisited," Axford (1962) considers "whether or not there is a direct and clear-cut relationship between the size and rate of acquisition of the library and the quality of education offered by the university" (pp. 345, 347), as Rider had indicated. He then presents evidence that, of 25 academic libraries with book stocks in 1960 that exceeded one million volumes, 20 appeared in Berelson's (1960) "most mentioned" list of 22 well-regarded graduate institutions. From this, Axford concludes that "Rider's emphasis on the relationship between rate of growth of the university library and the overall quality of the educational program is still essentially correct" [emphasis added] (p. 347). Note, though, that Axford's 25 libraries were selected because of their collection size, not their rate of growth, and in fact, their growth rates were shown to vary widely, but no analysis was offered that related these to "quality." Piternick later noted Axford's "debatable conclusions" (1963, p. 227), then proceeded to show that data nearly identical to Axford's revealed no significant correlation between growth rate and educational quality rankings but did reveal large positive correlations between collection size and quality (two coefficients, based on 1946 and 1960 holdings data, were .76 and .87). Interpreting these results, he also cautions against the conclusion that there are causal connections between the variables, and describes instead how other factors could underlie and give rise to the correlations.

Turning now to the Purdue studies (see Appendix A), many contents of those nine reports are devoted to description and to the extension/forecasting of specific growth trends, so specific that, in 28 instances, a forecast could be used to determine a precise, expected level of a given variable for any year, from 1965 through 1980 (see, e.g., Purdue, 1965, p. 21). Nevertheless, the Purdue studies also hedge these forecasts, indicating why they might be increased as well as decreased. In discussing its curve-fitting/forecasting procedures, the authors say: "It is recognized that no provision is made for an eventual deceleration of growth" and

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[3] The evidence that Metcalf's conclusion was premature, at least, can be seen in Purdue's Figs. 1, 14, and/or 17 (e.g., 1965, pp. 21, 34, 37) or in the current versions of those figures, presented below.

[4] Two quick calculations provide a crude credibility test for one of Metcalf's (1955) estimates, and show that, when his words were published, California-Berkeley and the other five libraries that are grouped with it had collections that averaged 2.14 million volumes, compared to Harvard's then-current 5.83 million. Thirty years later, in 1985, their collections averaged 5.60 million, which, incidentally, reflects a 162% increase, and represents a doubling period just greater than 22 years. Whatever else these figures mean, they do not invalidate the warning.

> . . . although some of the fitted curves, when extended some years beyond 1980, indicate inconceivably high levels, there is little basis for expecting an early deceleration in library growth. In short, the records of growth since 1951, including the most recent years, and the unfaltering growth of even the largest libraries, indicate that this growth will not soon decelerate. Upper limits are not apparently being reached and it seems unlikely that they will even be approached during the fifteen years immediately ahead. (1965, p.20)

Then, to support the argument that its forecast of average collection growth was probably conservative, Purdue analyzes the implications of observed acquisition[5] trends, as follows:

> On an annual basis, this [prediction that 1980 collections will average 2.86 million volumes] suggests that average acquisitions during the next sixteen years will be about 86,000 volumes. On the average, the ARL libraries are already acquiring 70,000 volumes and the prospects for continuing and substantial increases are great. It seems very likely that the average rate of acquisition will surpass 86,000 volumes in 1966-67[6]. This, plus the clear probability of continuing increases in acquisition rate, make the VH [collection size] prediction of 2.86 million volumes seem unreasonably low. As an alternative to this apparently low figure, it is possible to accumulate the predicted acquisitions (VA) for the next sixteen years, then to add these to the VH figure for 1963-64. When this is done, the VH prediction for 1980 is found to be 3.75 million. (1965, p. 49)

Using the same rationale, Purdue also explains that the predicted median collection for 1980 should increase to "approximately three million volumes, rather than 2.3 million." Then, the last paragraph on the topic includes: "a review of the reasons for and against the alternative VH predictions leads the writers to favor the larger estimates . . . [and] simple arithmetic will lead to the conclusion that VH predictions which are based only on recent VH data err in the direction of under-estimation" (p. 50)[7].

Later, in the seventh of Purdue's nine reports (1971), 28 revised forecasts were added to the original 28 "fitted curve" forecasts, although not because of any apparent ambivalence. Instead, during the six years following creation of the original forecasts, data representing those years had accumulated and the "new curves based on 20 years [of] data were determined in the same manner as the originals (i.e., both curves are parabolas that best fit the data)" (p. 9). In general and in comparison with the original fitted curves, the new forecasts: 1) yielded moderately increased estimates of future collection size; 2) had little or no effect on estimates of future "volumes added," except for smaller libraries; 3) estimated future expenditure levels that would be moderately or considerably higher than originally estimated; and 4) tended to estimate future professional staff size at higher levels than originally. In the last two Purdue reports (1972, 1973), both sets of forecasts are retained, and they are incorporated also in the presentation of Figs. 1-28, below.

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[5] "Acquisitions" refers here to the variable that is more accurately called "gross volumes added."

[6] In fact, the 1966-67 VA average was 93,625; one year earlier, it just managed to "surpass 86,000," and was 86,070.

[7] A friend has noted that the reasoning just quoted treats "gross" volumes added, or VA, as if it were "net" volumes added, or $VH_{year\ n}$ minus $VH_{year\ n-1}$. Logically, these should be two non-equivalent variables; however, one author (W.S.), who was involved in data collection and in preparing the first five Purdue reports, recalls that the early Purdue data seemed to show repeated instances of net equalling gross VA and this led to an assumption of practical equivalence.

Leach (1976) undertook a partial reexamination of the Rider and Purdue studies and his article abstract states that "this study . . . discredits the validity of Rider's hypothesis, notes the limitations of the Purdue study growth-rate figures, and tentatively identifies the collection size level past which growth-rate deceleration begins" (p. 531). However, inconsistencies prompt serious doubts concerning each of these claims. Concerning Rider's "hypothesis," Leach argues without data, yet data are essential to show that collections either did or did not grow as Rider had indicated. Moreover, in summarizing selected Purdue findings, Leach's argument is undermined when he notes that: "these figures seem to substantiate the accuracy of Rider's hypothesis" and he then cites, in apparent approval, two reviewers whose positions agree with this. The first of these, Garrison (1966), wrote that "the chief impression the reader gains from an examination of the [Purdue] report is that Fremont Rider was, in general, correct in his ominous predictions" (p. 170). The second reviewer, Talmadge (1966), is quoted as follows: "this absorbing work might well have been dedicated to the late Fremont Rider," then Talmadge adds that the growth of even the fourteen largest libraries, as reported by Purdue, was not an "essential undermining of Rider's thesis" (p. 319). Thus, contents of Leach's text contradict the article's abstract.

The "limitations of [Purdue's] growth-rate figures" to which Leach refers are that the actual growth of an individual library is not likely to match closely the growth of a statistical composite library, so "for that [individual] library the utility of the composite figure . . . is diminished" (1976, p. 538). The implication given is that librarians should be cautioned against treating a composite's trends as a recipe for an individual library to follow; however, Purdue did not recommend such treatment and instead recommended against it, as follows: "these analyses may be regarded as suggestive of events within individual libraries, although the course of growth for the individual library is rarely as regular as that of a group" (1965, p. 75).

Third and finally, Leach notes the relatively low growth rates generally associated with larger libraries and states "that the size level of 3 million volumes is the threshold beyond which a deceleration in the rate of collection growth can be expected" (1976, p. 539). However, he then proceeds to note that Chicago, Cornell, and California-Berkeley, as well as Toronto, violate the stated principle, so the "inverse relationship" between collection growth "and collection size can be suspended," which is to say that the threshold effect is present, except when absent.

Three years after the Purdue studies ended, Drake, an author of Purdue's ninth and final report, published "Forecasting library growth" (1976), followed one year later by Academic research libraries: A study of growth (1977). The earlier article describes and discusses alternative forecasting methods and includes a sample forecast that is based on an equation from Baumol and Marcus (1973, p.94). When the equation is applied to a set of Purdue data, the prediction it yields is that Purdue's total library operating expenditures in 1975 would be $1.129 million, but Drake then reports that "actual operating costs . . . will be more than double the projected figure" (1976, p.58)[8].

Drake's second report (1977) is from the same source as the original Purdue series and is essentially a sequel to that earlier series but with important modifications. Data for the study span the years from 1966 through 1975 and are derived from 62 ARL members, including the 58 libraries represented in the Purdue studies (and in this present study), plus Connecticut, Georgetown, McGill, and Toronto. In Table I and its accompanying figures, annual median values for total expenditures, salaries and wage expenditures, staff size, collection growth rates, and some related variables are shown, then the corresponding data for each individual library are presented in tables and figures numbered 2 through 63. Library rankings for the years 1971 through 1975 are presented, as well as Fall, 1974 university enrollments. Compared to Purdue's earlier studies, Drake's two principal omissions are "quantitative predictions" of future growth and Purdue's four library subgroups, "Large" to "Small," which had been based on the 58 libraries' 1962-63 collection size (see also Table 3 and Appendix D [of RLT-I]). Predictions were omitted because "reliable projections of library growth necessitate a detailed and careful analysis of many factors to determine which elements affect library growth" and this could not be done "within reasonable time and cost constraints" (p.2). The four subgroups were omitted "because libraries within each group have experienced different growth rates and patterns resulting in internal inconsistencies" (p.2).

Concerning these omissions and the reasons given for them, we would suggest that the goal in forecasting is valid "projections of . . . growth," and that reliability is, technically, necessary but not sufficient in achieving validity. Secondly, although libraries in Purdue's four size subgroups had "experienced different growth rates . . . ," as Drake indicates, data she presents in Table 64 also show that, when the libraries are ranked according to their 1975 collection size, 41 of the 58 libraries, or 71 percent, remain in the subgroup to which they were originally assigned (see also Appendix D [of RLT-I]).

A recent study by Seibert (1985) briefly examines the fate of a few Purdue forecasts and, as a refinement to Rider's simpler methods, applies curve fitting to his two principal data sets. The results can be summarized by saying that fitted curve forecasts are shown to work well at times, apparently--or usually--with respect to collection and expenditure growth but not in predicting growth of "volumes added." The article's three figures present evidence of three collection growth trends, together with curves fitted to several of their earlier data points. Each of the trends has the appearance of smoothness or consistency but not necessarily of successful predictability, and it is fair to say that one of the three predictions succeeds; another succeeds moderately well, considering the 150 year span with which it deals; and a third fails because it underestimates the remarkable growth that in fact occurred. In Fig. 1, which is a simpler version of Fig. 1 [in RLT-I], Seibert shows that Purdue's original prediction of the average 1980 collection (1965, p.21) was in error by only 2.5 percent 16 years after its creation. The second figure demonstrates that, even when past growth yields a prediction of continuing parabolic growth, that prediction can prove to be too conservative. The third figure shows that, for 150 years, the collections of several older university libraries seem to have continued on a smooth course of parabolic growth, seemingly unaffected by the new technologies and other historical developments that might have altered the course. The article concludes more with frustration than ambivalence, noting that "results continue to imply that future growth will produce collections that common sense must deny. For this conflict to be resolved, growth rates must eventually decelerate--but when, and how can we foresee it?" (p. 23).

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[8] ARL statistics record Purdue's 1975 library operating expenditures as $2.811 million.

In two recent articles, Molyneux (1986a, 1986b) argues against the common conclusion that library growth is exponential, and he begins the first article with these words:

> The present study contends that library growth has not been modeled well and that no successful method of projecting growth has been developed. In order to predict the future size of libraries a model of library growth has to be formed that can be projected. The process of modeling involves accurately describing the growth observed over a period and from this description forming an understanding of the processes at work. When this understanding has been formed, a mathematical model can be developed that incorporates the description of growth observed in the past and the understanding of the processes at work. The resulting mathematical model is what can be projected into the future. (p.6)

To test the practical value of this advice, we suggest that the reader replace those words that refer to library growth with others that refer to some other unexplained phenomenon, such as "the courting behavior of Trobriand Islanders," then re-read Molyneux's text otherwise verbatim.

Molyneux fails to recognize that the forecasts in question necessarily rely on methods that are only correlational, and that correlations can yield predictions that may or may not be useful, but they cannot establish the presence of causal connections between variables. To verify that this is so, consider the case of two timepieces (any two operating wristwatches will do) from which we will take, say, 50 simultaneous readings tomorrow afternoon. We record and correlate the paired readings, producing a coefficient that will be at least .95. With a coefficient this large, we can create a scheme to predict rather accurately the time shown on one from the time on the other, but we would not conclude that the action of one causes action in the other. Instead, we accept that some unexamined, underlying causes are operating on both (or perhaps we only become suspicious about underlying causes later, after one watch stops).

The article's other problems include: 1) reliance in four tables and in text on hypothetical growth data that have unknown validity and that can (mis)behave however their inventor chooses (pp. 10-12); 2) the undocumented assertion that "the most common error in the literature is assuming exponential growth between widely separate years" (p. 13); 3) absence of stated criteria for deciding "that no successful method of projecting growth has been developed" (p. 6); 4) erroneous description of the Purdue studies' "stated purpose" (p. 21); and 5) the incredible statement that "it is strange that no writer has discussed the implications of exponential growth" (p. 26), when, to cite one famous 43 year-old estimate, "the Yale Library will, in 2040, have approximately 200,000,000 volumes, which will occupy over 6,000 miles of shelves. Its card catalog--if it then has a card catalog--will consist of nearly three-quarters of a million catalog drawers . . . ." (Rider, 1944, pp. 12-13).

We now consider Molyneux's second recent article (1986b), the abstract of which begins with: "The results of a study on the growth of ARL libraries since 1962/63 are shown to argue against the commonly held notion that library growth is an exponential phenomenon" (p. 211). For reasons that are given below, this statement must be challenged. To do this, we would note, first, that since the time of Fremont Rider, "library growth" studies have referred primarily and directly to the course of research library collection growth over some substantial period of years, and Keyes Metcalf to the contrary notwithstanding, much evidence, including that from "large" libraries, has revealed accelerating, curvilinear growth (e.g., Purdue, 1965, p. 37). Whether the relatively recent and current growth continue essentially as before has not been established, but a credible answer to the question requires, at a minimum, something like the following evidence: 1) authentic research library collection statistics; 2) that span a sequential series of recent years; 3) that are derived from a rationally chosen group of several libraries; and 4) that inferential statistics--or informed colleagues--indicate are devoid of significant curvilinear trend.

Instead, Molyneux presents only the following: 1) in Table 1, the same hypothetical collection and "volumes added" data that appear in Tables I and II of the previous article; 2) in Table 2, the 1983/84 collection data of 17 or 20 libraries in three ARL subgroups, together with the mean, median, and summed volumes for each group; 3) in Table 3, the 1983/84 mean, median, and summed volumes of ARL's 105 academic member libraries; 4) in Figure 1, four plots showing the average year-by-year gross volumes added by ARL libraries identified in Tables 2 and 3; and 5) in Figure 2, four similar plots that show net volumes added by the same ARL library groups.

Note that the evidence in his Table 1 is hypothetical, not authentic, and it thus establishes nothing concerning actual collection growth. Then note that his Tables 2 and 3 present authentic collections data, but because they report only one year, 1983/84, they lack sequence and they thus lack relevance to questions of growth. And note, too, that his Figs. 1 and 2 do present authentic, sequential data but none that refers to library collections. Instead, the data refer to "volumes added," a marginally relevant, a distant, or a tangential measure that does not translate readily or surely into conclusions concerning collection growth. Thus, the absence of authentic, generalizable, sequential collections data not only undermines the argument, it is also perplexing because the relevant "collections" data are exactly as accessible as the marginally relevant "additions" data that Molyneux presents.

The forerunner of ARL's annual Statistics, the "Gerould/Princeton" statistics, was a series of compilations that include annual statistics of 60 academic libraries and that extend, in some cases, from 1907-08 through 1961-62. The collected data include variables similar or identical to those that ARL continues to collect: volumes held, volumes added, materials and binding expenditures, etc., and until recently, these compilations had apparently not been brought together between two covers. Now, thanks to Molyneux (1986c), ARL, and various collaborators or contributors, the statistics have been assembled and organized and they represent a unique and accessible record of academic library growth during the early part of this century. Molyneux has appended recent ARL statistics to those of Gerould/Princeton, so that portions of the data extend through 1983-84.

For present purposes, Molyneux's chapter 4 is of most interest. Entitled "Library growth from 1907/08 to 1983/84," the chapter consists largely of plots that show "increase in volumes . . . as a percent [:] 1907/08-1983/84," for each of 49 individual libraries, as well as averaged over a group of twelve libraries. The highest average, 9.1%, was in 1913/14 and the lowest, 3.0%, was in 1982, and during three years of World War II, 1943-45, the averages were 3.5, 3.2, and 3.3. During the large majority of years, collections increased between four and six percent. In four appendices, Molyneux also lists the data sources consulted, and the discrepancies found when alternative sources were compared.

Finally, we should note that a brief and preliminary report of the present research was prepared for distribution to those attending the April-May 1986 ARL meeting (Seibert, Games, Kuenz, and Gregg, 1986), and its results consist of preliminary versions of Figs. 1-10, below. In discussing these results, the authors mention that acquisition increases had stopped "about 1970 or shortly afterward," that the total expenditures "1984 average is $9.58 million, which represents a 20-fold increase of the 1951 level," and also represents average annual increases of about nine percent, and that both professional and non-professional staff size had shown "no evident increase since 1970 or 1971" (pp. 9-11). It should be noted too that the forerunner and counterpart of that brief and preliminary report is one that was prepared for distribution at the July 1965 ARL meeting. It consisted largely of the then-current versions of Figs. 1-28 [in RLT-I], and is published in the meeting's minutes (Moriarty, 1965).

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Appendix C

NCES Data Source Documents

Data
Year Source Document

1969: Opening Fall Enrollment in Higher Education, 1968: Part B - Institutional Data. U. S. Department of Health, Education, and Welfare, Office of Education. National Center for Education Statistics. No. OE-54003-68 Part B. USGPO, February, 1969.

Students Enrolled for Advanced Degrees Fall 1968. U. S. Department of Health, Education, and Welfare, Office of Education, National Center for Education Statistics. No. OE-54019-68. USGPO, 1972.

Earned Degrees Conferred: 1968-1969 Part B - Institutional Data. Bachelor's and Higher Degrees. U. S. Department of Health, Education, and Welfare,Office of Education, National Center for Education Statistics. No. OE-54013-69-B. USGPO, 1971.

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Students Enrolled for Advanced Degrees Fall 1970. U. S. Department of Health, Education, and Welfare, Office of Education, National Center for Education Statistics. No. (OE) 72-64. USGPO, 1971.

Earned Degrees Conferred 1970-1971. U. S. Department of Health, Education, and Welfare, Education Division, Office of Education, National Center for Education Statistics. No. (OE) 73-11412. USGPO, 1973.

1972: Fall Enrollment in Higher Education 1971. U. S. Department of Health, Education, and Welfare, Education Division, Office of Education, National Center for Education Statistics. DHEW Publication No. (OE) 73-11414. USGPO, 1973.

Students Enrolled for Advanced Degrees, Fall 1971. U. S. Department of Health, Education, and Welfare, Office of Education. No. OE-74-11426. USGPO, 1974.

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1973: Fall Enrollment in Higher Education 1972. U. S. Department of Health, Education, and Welfare, Education Division, National Center for Education Statistics. DHEW Publication No. 75-121. USGPO, 1974.

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1974: Fall Enrollment in Higher Education 1973. U. S. Department of Health, Education, and Welfare, Education Division, National Center for Education Statistics. No. NCES 75-121. USGPO, 1975.

Students Enrolled for Advanced Degrees, Fall 1973. U. S. Department of Health, Education, and Welfare, Education Division, National Center for Education Statistics. No. NCES 76-111. USGPO, 1976.

Earned Degrees Conferred 1973-1974. Institutional Data. U. S. Department of Health, Education, and Welfare, Education Division, National Center for Education Statistics. No. NCES 76-106. USGPO, 1976.

1975: Fall Enrollment in Higher Education 1974. U. S. Department of Health, Education, and Welfare, Education Division, National Center for Education Statistics. No. NCES 76-001. USGPO, 1975.

Students Enrolled for Advanced Degrees Fall 1974 Summary Data. U. S. Department of Health, Education, and Welfare, Education Division, National Center for Education Statistics. No. NCES 76-112. USGPO, 1976.

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Unpublished data: Earned degrees conferred 1981-1982. Bachelor's and higher degrees. U. S. Department of Education.

1983: Fall Enrollment in Colleges and Universities 1982. U. S. Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics. No. NCES 84-305. USGPO.

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1984: Fall Enrollment in Colleges and Universities 1983. U. S. Department of Education, National Center for Education Statistics. No. NCES 85-301. USGPO, June, 1985.

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1987: Prepublication data listings: Earned degrees conferred, Graduate enrollment, Total enrollment. U. S. Department of Education, National Center for Education Statistics.

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Appendix D

Canadian Data Source Documents

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Canada Year Book 1980-81. Table 23.39. Ottawa, CA: Statistics Canada, 1981.

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NB: Data for the years 1983-84 through 1988 were provided by the individual Canadian institutions.

Appendix E

Canadian and U. S. Dollar Conversion Factors*

	U. S. dollars in Canadian dollars	Canadian dollars in U. S. dollars
1969	1.0745	0.9306
1970	1.0724	0.9325
1971	1.0159	0.9843
1972	1.0031	0.9969
1973	0.9922	1.0079
1974	0.9892	1.0109
1975	0.9968	1.0032
1976	1.0056	0.9944
1977	1.0130	0.9872
1978	1.1030	0.9066
1979	1.1407	0.8767
1980	1.1680	0.8850
1981	1.1843	0.8444
1982	1.2143	0.8235
1983	1.2349	0.8098
1984	1.2548	0.7969
1985	1.3388	0.7469
1986	1.3817	0.7237
1987	1.3602	0.7352
1988	1.2826	0.7797

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* Conversion factors are for fiscal years (July 1 - June 30). Conversion factors for the years 1969-80 were taken from Canada Year Book 1976-77 (Table 21.35) and Canada Year Book 1980-81 (Table 23.39). Factors for subsequent years (1981-88) are from the annual ARL Statistics for those years.

Appendix F

Selected Means for the Seven Canadian Libraries, 1976-1988*

YEAR	BX	SX	LPSP	PSS	NPSS	TX	CXPS	SALR	NPSR	BKR	CURSER
1976	1827651	4119459	11092	89	307	6382891	283.70	.631	3.62	.299	19111
1977	1808158	4516062	12112	84	280	6869216	298.34	.645	3.48	.281	18435
1978	2015940	4880669	12823	83	285	7433822	325.53	.645	3.56	.286	19330
1979	2307518	5167613	13693	83	272	7971388	351.37	.639	3.41	.305	19533
1980	2542370	5486755	14627	81	272	8499743	374.75	.631	3.53	.317	22057
1981	2864050	6163937	17286	81	266	9694066	419.37	.624	3.45	.312	21293
1982	3126015	6651504	18009	79	265	10612204	437.60	.610	3.60	.307	21835
1983	3357540	7316136	20299	79	256	11457690	448.34	.625	3.37	.311	21719
1984	3627226	7850531	20814	78	250	12208792	472.71	.624	3.38	.317	22798
1985	3909151	8115898	21235	78	250	13072332	511.15	.603	3.31	.323	22829
1986	4137331	8386777	22523	79	246	13427868	527.37	.607	3.25	.327	21308
1987	4605281	8708700	23342	79	245	14622247	568.66	.584	3.28	.335	21092
1988	5183121	9179949	24188	81	247	15329881	593.01	.580	3.18	.357	20236

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* All expenditure statistics are recorded in Canadian dollars.

Appendix G

Tables and Figures for Large, Mid-size, and Small Composite Libraries

The pages of this Appendix summarize the trends of the three composite libraries that were created on the basis of the libraries' 1987 collection size (see Table 3' for definitions). The trends of the Large composite are summarized in Table 8, the Mid-size composite in Table 9, and the Small composite in Table 10. Then, in the six pages that follow, Figs. 13 through 18 show selected trends of the libraries, beginning with Volumes Held (Fig. 13) and Volumes Added (Fig. 14) and concluding with Professional and Nonprofessional Staff Size (Fig. 18).

Table 8

The Large (Lge) ARL Library, 1976-1988(n = 12)

YEAR	VH	VA	BX	SX	TX	LPSP	PSS	NPSS	MFLM	CURSER	TENR	GENR	PHD
1976	1813174	99835	1673665	3185714	5208060	10702	81	214	993389	N/A	26139	4879	210
1977	1842245	98829	1684695	3410111	5526032	11388	79	197	1068706	N/A	25742	4729	202
1978	1933366	97417	1792627	3501017	5752785	11589	78	201	1150056	N/A	25351	4804	207
1979	2016818	94199	2051002	3672370	6200818	12278	78	197	1277174	N/A	25656	5008	205
1980	2120182	92947	2238231	3996737	6733939	12903	81	203	1438880	N/A	26082	4953	200
1981	2204432	92522	2509404	4440341	7439848	14422	81	199	1597774	N/A	26740	5110	205
1982	2291669	96646	2764243	4755355	8145131	15067	82	205	1760132	N/A	27515	5213	203
1983	2366644	94521	2838195	5085946	8638644	15580	81	199	1883035	N/A	27684	5318	204
1984	2447101	92434	2969336	5337349	9068957	16106	82	200	2069564	N/A	27918	5437	197
1985	2531943	96183	3134726	5487172	9548182	17058	82	199	2229148	N/A	27732	5451	208
1986	2619895	95279	3504990	5681850	10215095	17901	84	199	2166337	N/A	27805	5561	216
1987	2708088	93133	3952964	6136507	11255313	19742	86	201	2218459	N/A	27978	5743	221
1988	2792642	91875	4217662	6676622	12031424	20291	87	206	2348792	N/A	28829	6019	229

YEAR	PINC	BKR	CXPS	GRDR	VAPG
1976	.057	.346	201.65	.19	22.9
1977	.054	.336	216.04	.18	23.2
1978	.051	.338	231.72	.19	21.9
1979	.047	.350	248.70	.19	20.4
1980	.045	.347	266.80	.19	20.7
1981	.042	.350	286.54	.19	19.5
1982	.042	.353	303.82	.19	19.9
1983	.040	.341	318.62	.19	19.2
1984	.038	.339	333.36	.20	18.5
1985	.038	.339	353.34	.20	19.1
1986	.036	.349	378.92	.20	18.4
1987	.035	.359	413.43	.21	17.4
1988	.034	.359	430.84	.21	16.2

Table 9

The Mid-size (Mid) ARL Library, 1976-1988(n = 11)

YEAR	VH	VA	BX	SX	TX	LPSP	PSS	NPSS	MFLM	CURSER	TENR	GENR	PHD
1976	1240760	76280	1284355	1822724	3384900	10105	48	114	734329	N/A	14670	2177	124
1977	1291213	55714	1175493	1960040	3360949	10667	49	117	800279	N/A	14942	2216	120
1978	1347976	55183	1241181	2111538	3650976	10923	50	119	879041	N/A	14528	2234	111
1979	1403640	60390	1397056	2220230	3940569	11226	49	119	999233	N/A	14404	2234	104
1980	1424041	50619	1487731	2361900	4234541	12028	48	119	1062361	N/A	14535	2330	104
1981	1462726	48609	1690496	2668533	4775346	13272	48	117	1173158	N/A	14988	2352	110
1982	1531519	47961	1804678	2946891	5343716	14101	48	120	1262935	N/A	15530	2327	110
1983	1579971	52172	2021285	3026962	5629691	14456	49	119	1352592	N/A	16033	2344	114
1984	1633655	56995	2199428	3205438	6062704	15234	51	118	1445574	N/A	16139	2372	112
1985	1700351	62258	2397743	3446195	6655438	17036	52	120	1577459	N/A	16107	2372	112
1986	1761871	54971	2606818	3720822	7186334	18281	53	123	1592388	N/A	16162	2385	110
1987	1808538	54798	2822193	4045035	7782358	20085	53	125	1701982	N/A	16762	2776	121
1988	1823041	55484	3029836	4342351	8456584	20445	56	126	1875941	N/A	17254	2803	117

YEAR	PINC	BKR	CXPS	GRDR	VAPG
1976	.060	.372	293.35	.15	48.5
1977	.043	.358	268.33	.15	30.8
1978	.041	.347	303.32	.15	29.5
1979	.043	.359	325.20	.15	35.8
1980	.036	.361	348.65	.16	28.3
1981	.033	.362	381.45	.16	27.3
1982	.031	.343	413.28	.15	25.4
1983	.033	.362	431.23	.15	28.1
1984	.035	.366	456.07	.15	29.5
1985	.036	.362	503.21	.15	31.7
1986	.031	.367	550.99	.15	27.5
1987	.030	.368	578.30	.17	26.3
1988	.030	.361	606.42	.17	25.7

Table 10

The Small (Sml) ARL Library, 1976-1988 (n = 12)

YEAR	VH	VA	BX	SX	TX	LPSP	PSS	NPSS	MFLM	CURSER	TENR	GENR	PHD
1976	1055462	53930	1008658	1482025	2694491	10134	47	91	810576	N/A	15317	2800	123
1977	1115051	57536	1128633	1611783	3051706	10742	47	101	896813	N/A	15390	2692	125
1978	1142063	52886	1167164	1743601	3269641	10831	50	106	979724	N/A	15158	2849	120
1979	1132396	47333	1261371	1932552	3532202	11230	51	101	1059926	N/A	15310	2782	124
1980	1182983	47223	1400429	2068436	3832276	12117	50	99	1164765	N/A	15346	2803	121
1981	1235751	45274	1615955	2306109	4401003	12944	52	101	1248610	N/A	15753	2816	121
1982	1280886	46761	1796022	2606110	4950790	14082	53	101	1387360	N/A	15758	2863	127
1983	1326067	53172	1958199	2708813	5403670	14344	53	101	1557497	N/A	15972	2918	127
1984	1371274	50203	2186612	2938626	6003560	15163	53	103	1707440	N/A	15964	2961	137
1985	1415926	53442	2208765	2998305	6369366	16387	55	101	1879085	N/A	15843	2915	130
1986	1403448	47887	2355242	3213581	6496752	17388	56	101	1474657	N/A	15666	2959	141
1987	1444054	48670	2647521	3268143	6661778	19676	54	100	1558645	N/A	15662	3404	140
1988	1475406	41741	2967401	3606735	7430030	19586	55	104	1798618	N/A	15708	3457	146

YEAR	PINC	BKR	CXPS	GRDR	VAPG
1976	.053	.372	215.66	.20	21.9
1977	.052	.368	240.35	.19	23.4
1978	.047	.357	262.03	.20	20.2
1979	.042	.356	281.85	.20	18.7
1980	.041	.367	319.13	.20	19.7
1981	.037	.371	359.99	.19	19.4
1982	.037	.370	392.80	.20	19.0
1983	.040	.373	428.85	.20	21.4
1984	.036	.366	473.07	.20	20.0
1985	.038	.360	501.61	.20	22.0
1986	.034	.366	524.42	.20	19.1
1987	.034	.397	535.81	.23	18.4
1988	.029	.406	590.87	.24	15.1

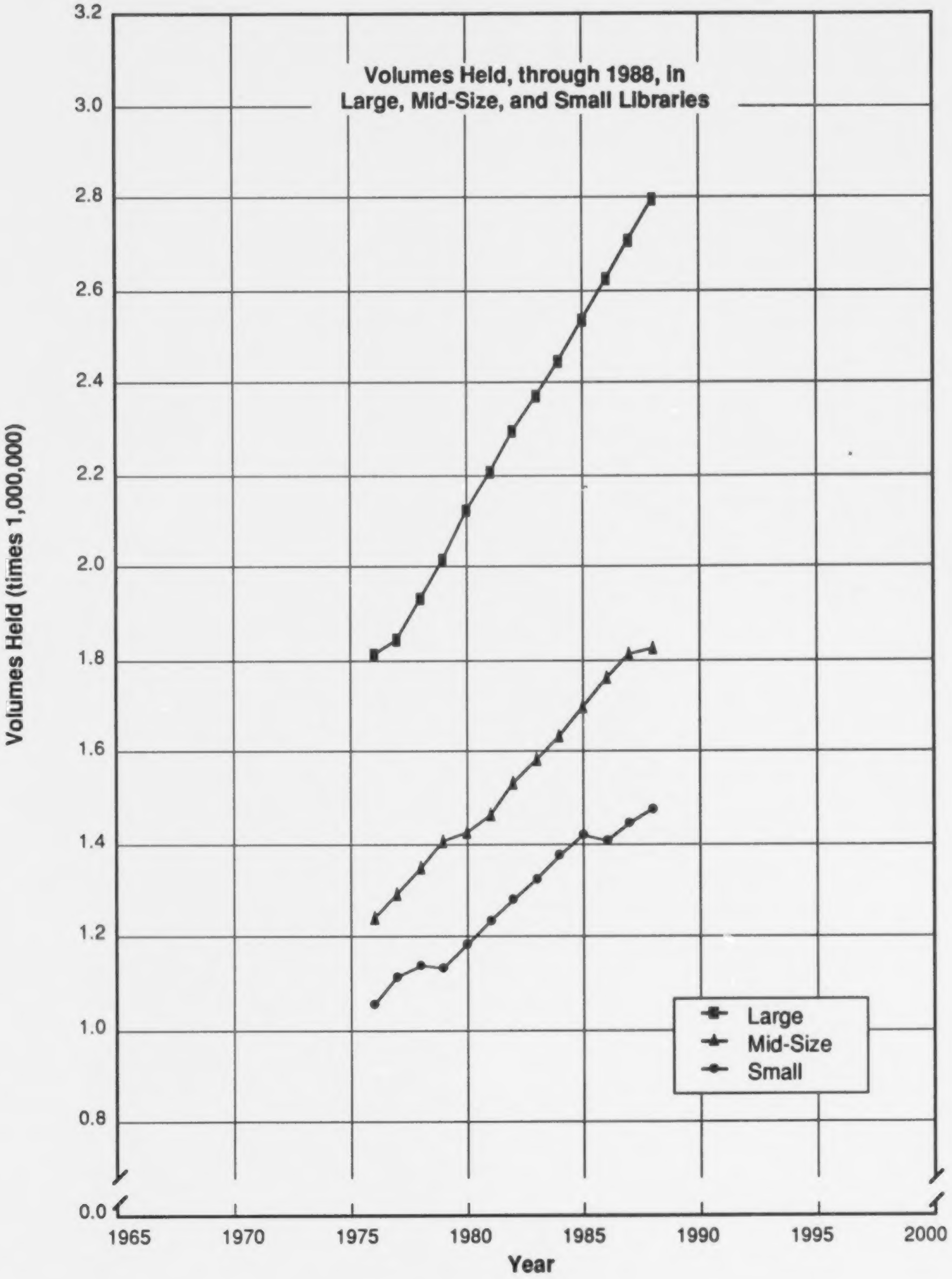

Figure 13. **Volumes Held (VH) in the Large (Lge), Mid-Size (Mid), and Small (Sml) Composite Libraries**

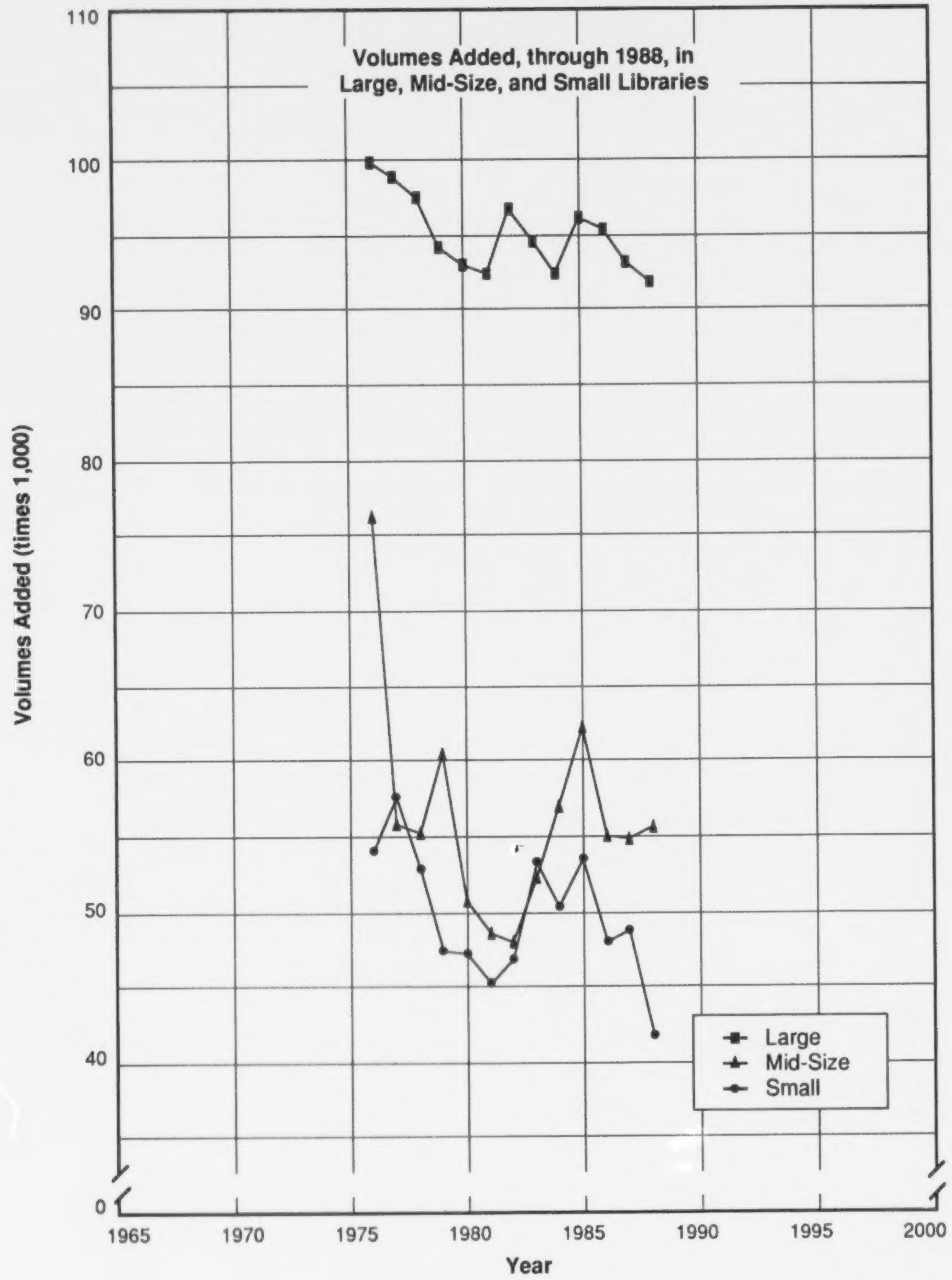

Figure 14. **Volumes Added (VA) in the Large (Lge), Mid-Size (Mid), and Small (Sml) Composite Libraries**

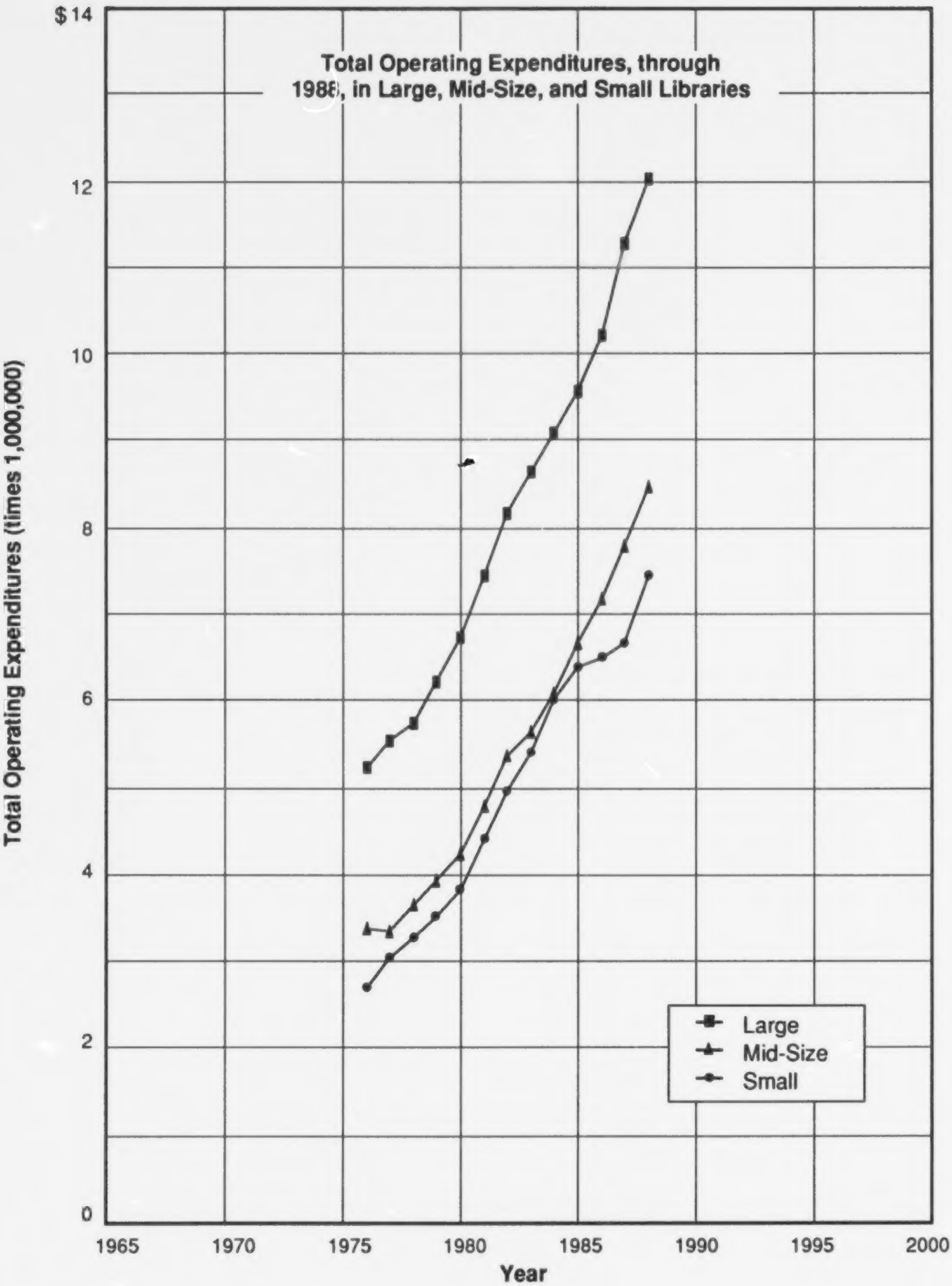

Figure 15. **Total Operating Expenditures (TX) in the Large (Lge), Mid-Size (Mid), and Small (Sml) Composite Libraries**

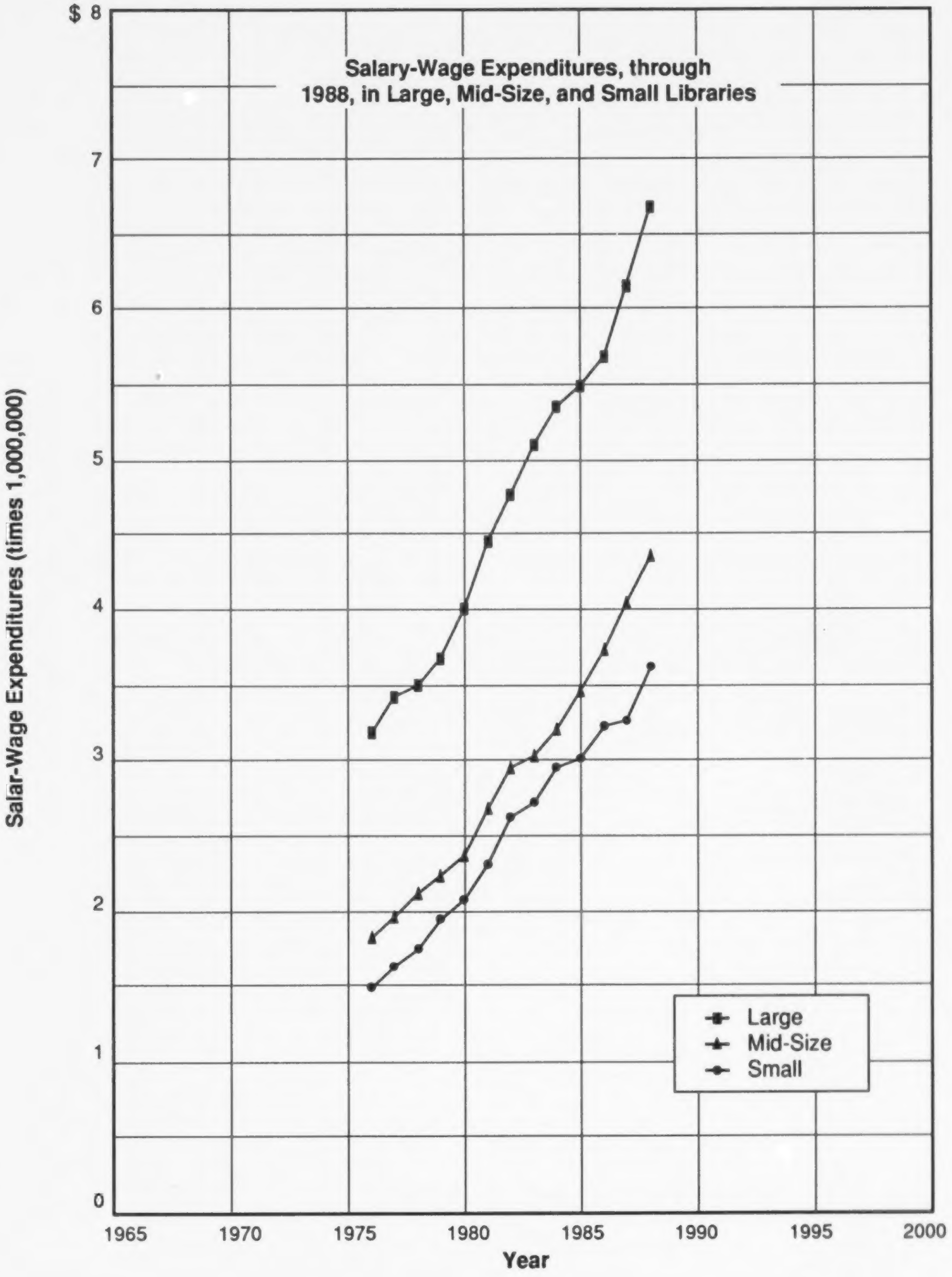

Figure 16. **Salary-Wage Expenditures (SX) in the Large (Lge), Mid-Size (Mid), and Small (Sml) Composite Libraries**

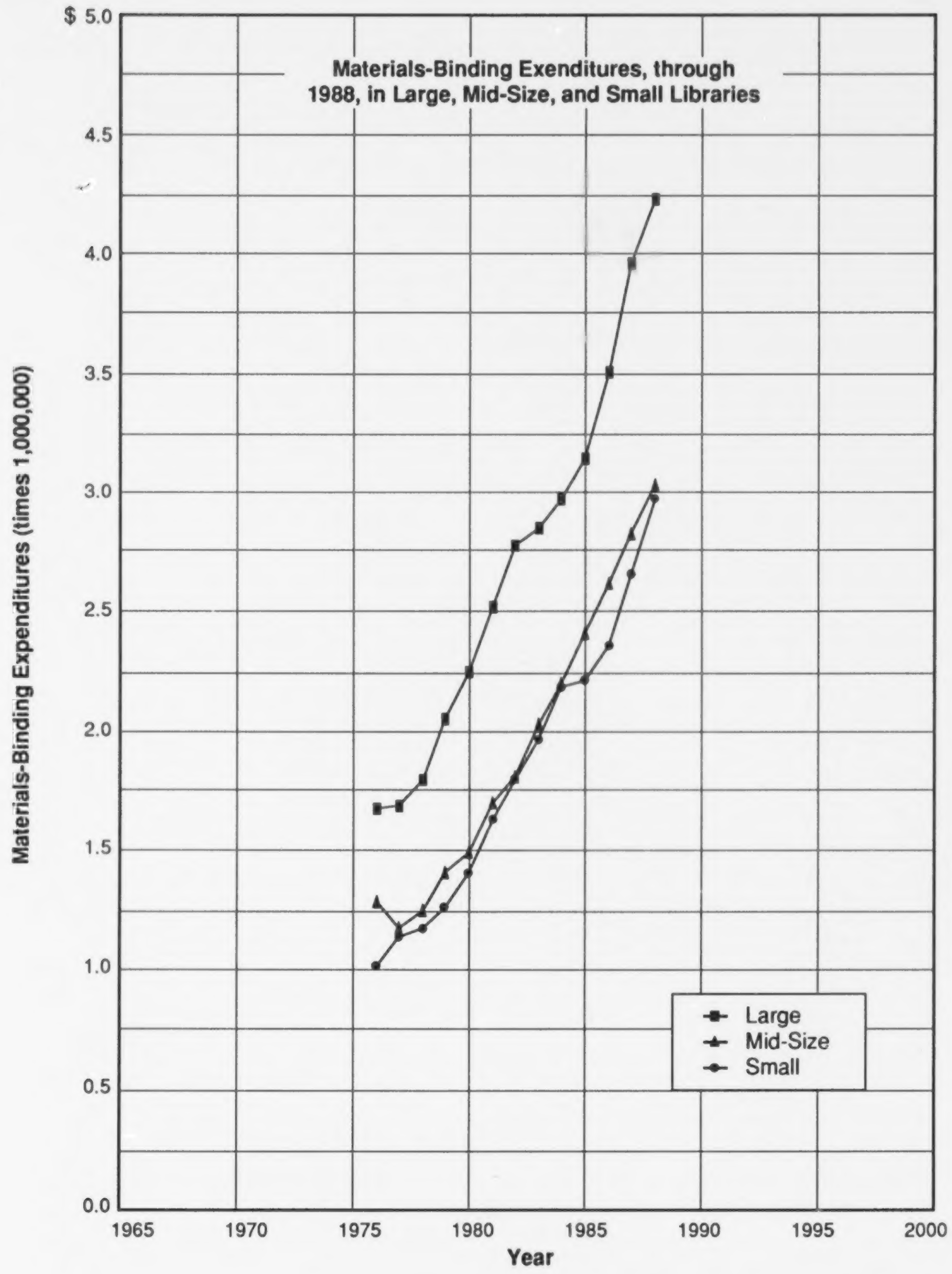

Figure 17. **Materials-Binding Expenditures (BX) in the Large (Lge), Mid-Size (Mid), and Small (Sml) Composite Libraries**

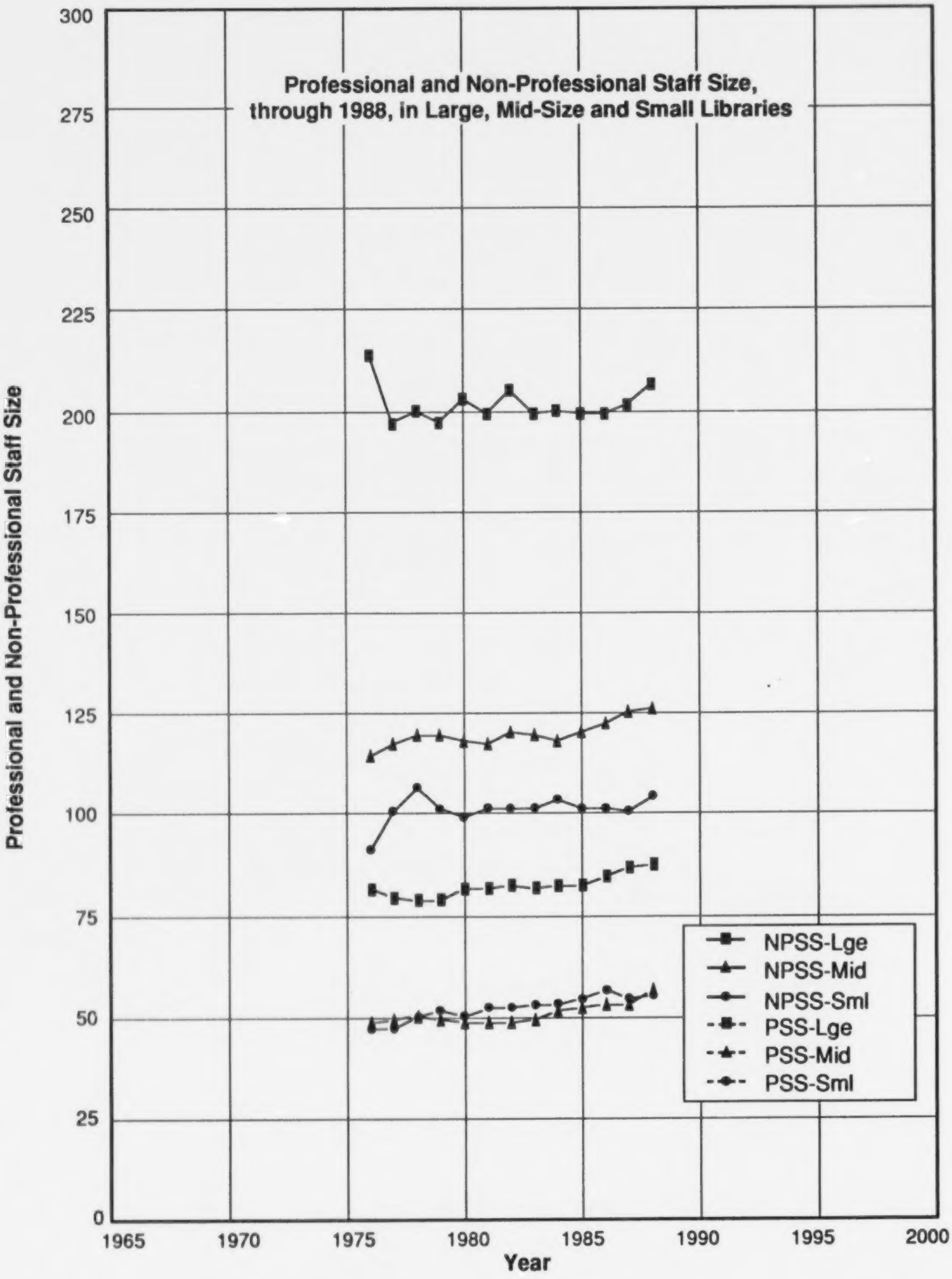

Figure 18. **Professional and Non-Professional Staff Size (PSS and NPSS) in the Large (Lge), Mid-Size (Mid), and Small (Sml) Composite Libraries**

Appendix H

Inflation Factors (Columns 3 and 5) Used in Figs. 19 and 19a

Column

1	2	3	4	5
YEAR	Consumer Price Index		GNP Implicit Price	
	(CPI-U) 1967=100	Inverted 1988=100	Deflator 1982=100	Inflator 1988=100
1988	354.3	100.0	121.7	100.0
1987	340.4	104.1	117.7	103.4
1986	328.4	107.9	113.9	106.8
1985	322.2	110.0	110.9	109.7
1984	311.1	113.9	107.7	113.0
1983	298.4	118.7	103.9	117.1
1982	289.1	122.6	100.0	121.7
1981	272.4	130.1	94.0	129.5
1980	246.8	143.6	85.7	142.0
1979	217.4	163.0	78.6	154.8
1978	195.4	181.3	72.2	168.6
1977	181.5	195.2	67.3	180.8
1976	170.5	207.8	63.1	192.9
1975	161.2	219.8	59.3	205.2
1974	147.7	239.9	54.0	225.4
1973	133.1	266.2	49.5	245.9
1972	125.3	282.8	46.5	261.7
1971	121.3	292.1	44.4	274.1
1970	116.3	304.6	42.0	289.8
1969	109.8	322.7	39.8	305.8
1968	104.2	340.0	37.7	322.8
1967	100.0	354.3	35.9	339.0

---

* The CPI-U data in Col. 2 are from the U. S. Dept. of Labor and are based on a 1967 index equal to 100. The GNP Implicit Price Deflator data in Col. 4 are from the U. S. Dept. of Commerce and are based on a 1982 index equal to 100. For use in Figs. 19 and 19a, both CPI-U and GNP were recalculated with magnitudes in reverse order and with 1988 equal to 100, as shown in Cols. 3 and 5. The CPI-U and GNP data sources are included in the Reference list.

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16. Abstract (Limit: 200 words)

This study is based on the annual statistics of 35 institutions, all members of the Association of Research Libraries. For 17 of the libraries, the statistics cover 1969-1988; for the rest, they cover 1976-1988. Procedurally, the study parallels both its 1987 ancestor (Research Library Trends, 1951-1980 and Beyond) and the earlier "Purdue Study" series, but here the 35 libraries are separate from, and many are smaller and younger than, the 58 included in the earlier work.

The study describes growth and change in library holdings, volumes added, professional and non-professional staff size, and expenditures for salaries and for materials and binding. Figures for graduate enrollment and Ph.D. degrees awarded are also included.

Expenditures, the most regular and predictable of the trends studied, are expected to continue to increase at a rate of about 8%-9% per year. Collections, which probably will continue to increase as a result of something like a "flywheel effect" (the continuing motion of a large mass that has been in motion "forever"), will probably not continue to double in less than 20-year intervals, as was common in the past; current rates of increase for collections are well below those of the 1960's, and they may decline further.

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